Computer Foundation for Tertiary Education Students

Student Study Guide

First Edition

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Table of Contents

About the Book 8
For Student 8
1.0 OBJECTIVE 9
1.1 HISTORY OF COMPUTER 9
1.2 CLASSIFICATION OF COMPUTER 10
1.2.1 Classification by Technology 10
1.2.2 Classification by Capacity 10
1.2.3 Classification by their Basic Operating Principle 13
1.3 THE COMPUTER EVOLUTION 14
1.3.1 The Mechanical Era (1623-1945) 14
1.3.2 First Generation Electronic Computers (1937-1953) 14
1.3.3 Second Generation (1954-1962) 15
1.3.4 Third Generation (1963-1972) 15
1.3.5Fourth Generation (1972-1984) 16
1.3.6 Fifth Generation (1984-1990) 17
1.3.7 Sixth Generation (1990 to Date) 17
1.4 COMPONENT *OF COMPUTER* (HARDWARE & SOFTWARE) 18
1.4.1 Components of Computer (Hardware) 18
1.4.1.2 Input *Unit* 19
1.4.1.2 Storage Unit 21
1.4.1.3 Memory Size 23
1.4.1.4 Output Input 23
*1.4.2 Components of Computer (*Software*)* 26
1.5 APPLICATION AREAS OF COMPUTER 28
1.6 SUMMARY 29
1.7 SELF-ASSESSMENT QUESTIONS 30
1.8 REFERENCE BOOKS ..... **ERROR! BOOKMARK NOT DEFINED.**
2.0 OBJECTIVE 31
2.1 INTRODUCTION 31
2.1.1 What is data processing 31
2.1.2 Processing Data versus Processed Data 31
2.2 Stages of Data Processing 32
2.3 Types of Data Processing 33
2.4 DATA PROCESSING PROCESS METHODS 34
2.4 SUMMARY 35
2.5 ASSESSMENT QUESTIONS 35
2.6 REFERENCE BOOKS ..... **ERROR! BOOKMARK NOT DEFINED.**
3.0 OBJECTIVE 36
3.1 INTRODUCTION 36
3.2 PRIVACY CONCERNS 36
3.3 INTELLECTUAL PROPERTY RIGHTS 37
3.4 EFFECTS ON SOCIETY 37

3.5 SUMMARY..... 38
3.6 ASSESSMENT QUESTION..... 38
3.7 REFERENCE BOOK ..... **ERROR! BOOKMARK NOT DEFINED.**
4.0 OBJECTIVE 39
4.1 INTRODUCTION 39
4.2 COMPONENTS OF ICT 40
4.3 COMMUNICATIONS NETWORKS..... 44
3.4 THE PRINCIPLES OF INFORMATION TECHNOLOGY 44
3.5 THE BENEFITS OF INFORMATION TECHNOLOGY 45
3.6 SUMMARY..... 46
3.7 ASSESSMENT QUESTIONS..... 47
4.8 REFERENCE BOOK ..... **ERROR! BOOKMARK NOT DEFINED.**
1.0 OBJECTIVE 48
1.1 INTRODUCTION 48
1.2 LANGUAGE TYPES..... 48
1.3 BUSINESS-ORIENTED LANGUAGES. 50
1.4 EDUCATION-ORIENTED LANGUAGES..... 51
1.5 WORLD WIDE WEB DISPLAY LANGUAGES 55
1.6 SUMMARY..... 56
1.7 ASSESSMENT QUESTIONS..... 57
1.8 REFERENCE BOOK ..... **ERROR! BOOKMARK NOT DEFINED.**
2.0 OBJECTIVE 58
2.1 INTRODUCTION 58
2.2 ALGORITHM..... 61
2.3 FLOWCHART 69
2.4 PSEUDOCODE 74
2.5 SUMMARY..... 77
2.6 ASSESSMENT QUESTIONS..... 77
2.7 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
3.0 OBJECTIVE 78
3.1 INTRODUCTION 78
3.2 PROGRAM STRUCTURE..... 80
3.3 BASIC LANGUAGE DATA TYPES 87
3.4 PROGRAM LOOPS 92
2.5 SUMMARY..... 94
2.6 ASSESSMENT QUESTIONS..... 95
2.7 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
4.0 OBJECTIVE 96
4.1 INTRODUCTION 96
4.2 DESKTOP APPS 96
4.3 MOBILE APPLICATIONS 98
4.4 INSTALLING NEW APPS..... 99
4.5 SUMMARY.....107
4.6 ASSESSMENT QUESTIONS.....108

4.7 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
5.0 OBJECTIVE 109
5.1 INTRODUCTION 109
5.2 DESCRIPTION OF SYSTEM DEVELOPMENT CYCLE.....110
5.3 DESCRIPTION OF EACH STAGE OF SYSTEM DEVELOPMENT CYCLE110
2.8 SUMMARY.....115
2.9 ASSESSMENT QUESTIONS.....115
2.10 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
1.0 OBJECTIVE 116
1.1 INTRODUCTION 116
1.2 BASIC COMPUTER OPERATION.....118
1.3 APPLICATION AREAS OF COMPUTER 120
1.4 SUMMARY.....122
1.5 ASSESSMENT QUESTIONS.....122
1.6 REFERENCES ..... **ERROR! BOOKMARK NOT DEFINED.**
2.0 OBJECTIVE 123
2.1 INTRODUCTION 123
2.2 BASIC CONCEPTS OF FILE MANAGEMENT 125
2.3 ORGANISING FILES AND FOLDERS 130
2.4 CREATING AND NAMING FOLDERS AND FILES.....133
2.5 FILE TYPES.....141
2.6 SUMMARY.....149
2.7 ASSESSMENT QUESTIONS.....149
2.8 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
3.0 OBJECTIVE 151
3.1 INTRODUCTION 151
3.2 ELEMENTS OF MULTIMEDIA SYSTEM 152
3.3 CHARACTERISTICS OF MULTIMEDIA SYSTEM 156
3.4 SIGNIFICANT FEATURES OF MULTIMEDIA COMPUTER SYSTEM .156
3.5 USES OF MULTIMEDIA PRESENTATION.....156
3.6 ADVANTAGES OF MULTIMEDIA.....157
3.7 DISADVANTAGES OF MULTIMEDIA.....157
3.8 APPLICATIONS OF MULTIMEDIA 157
2.9 SUMMARY.....159
2.10 ASSESSMENT QUESTIONS 160
2.11 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
4.0 OBJECTIVE 161
4.1 INTRODUCTION 161
4.2 WORLD WIDE WEB 162
4.3 SEARCHING FOR INFORMATION 163
4.4 CREATING AN E-MAIL ACCOUNT.....166
4.5 SUMMARY.....169
4.6 ASSESSMENT QUESTION.....169
4.6 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**

4.0 OBJECTIVE 170
4.1 INTRODUCTION 170
4.2 INSTALLATION OF OPERATING SYSTEM (WINDOWS) 172
4.3 VERSIONS, RELEASES, & COMPATIBILITY.....180
4.4 ENTERTAINMENT SOFTWARE 181
4.5 EDUCATION/REFERENCE SOFTWARE AND PRODUCTIVITY SOFTWARE 184
4.6 SUMMARY.....186
4.7 ASSESSMENT QUESTION.....187
4.8 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
5.0 OBJECTIVE 188
5.1 INTRODUCTION 188
5.2 TECHNIQUES OF ELECTRONIC DATA PROCESSING (EDP).....188
5.3 ELEMENTS OF ELECTRONIC DATA PROCESSING 190
5.4 STAGES OF ELECTRONIC DATA PROCESSING.....191
5.5 SUMMARY.....192
5.6 ASSESSMENT QUESTION.....192
5.7 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
1.0 OBJECTIVE 194
1.1 INTRODUCTION 194
1.2 CONVERSIONS.....195
1.2.1 Decimal to Other..... 195
1.2.1 Binary to Other 197
1.2.1 Octal to Other..... 198
1.2.1 Hexadecimal to Other 200
1.3 SUMMARY.....200
1.4 ASSESSMENT QUESTIONS 200
1.5 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
2.0 OBJECTIVE 202
2.1 1'S COMPLEMENT 202
2.2 2'S COMPLEMENT 203
2.3 GENERAL POSITIONAL NUMBER SYSTEM CONVERSION 206
2.4 NEGATIVE NUMBERS.....209
2.4.1 Signed Magnitude Number System 209
2.4.2 Complement Number System..... 210
2.4.3 Signed Addition/Subtraction..... 212
2.5 SUMMARY.....216
2.6 ASSESSMENT QUESTION.....217
2.7 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
1.0 OBJECTIVE 218
1.1 INTRODUCTION 218
1.2 TYPES OF PROCESSORS 220
1.3 THE EVOLUTION OF MICROPROCESSORS 222
1.4 BASIC TERMS USED IN MICROPROCESSOR.....222

1.5 APPLICATIONS OF MICROPROCESSOR.....223
1.6 SUMMARY.....223
1.7 ASSESSMENT QUESTIONS.....223
1.8 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
1.0 OBJECTIVE 224
2.1 MICROPROCESSOR ARCHITECTURE 224
2.2 INTEL 8085 224
2.3 CONTROL AND STATUS SIGNALS.....229
2.4 8085 INSTRUCTIONS 231
2.5 INSTRUCTION SET OF 8085 234
2.6 SUMMARY.....237
2.7 ASSESSMENT QUESTIONS 237
2.8: REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
3.0 OBJECTIVE 238
3.1 VECTOR PROCESSORS 238
3.2 ARRAY PROCESSORS OR SIMD PROCESSORS.....239
3.3 SCALAR AND SUPERSCALAR PROCESSORS 239
3.4 RISC AND CISC PROCESSORS.....240
3.5 DIGITAL SIGNAL PROCESSORS 241
3.6 SYMBOLIC PROCESSORS 242
3.7 BIT-SLICE PROCESSORS 242
3.8 TRANSPUTERS 242
3.9 GRAPHIC PROCESSORS.....243
3.10 SUMMARY 243
3.11 ASSESSMENT QUESTIONS 243
3.12 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
1.0 OBJECTIVE 244
1.1 INTRODUCTION 244
1.2 WORD PROCESSORS.....244
1.3 SPREADSHEETS 248
1.4 DATABASE MANAGEMENT SYSTEM (DBMS) 250
1.6 SUMMARY.....253
1.7 ASSESSMENT QUESTION.....254
1.8 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
2.0 OBJECTIVE 255
2.1 BASICS OF MICROSOFT WORD.....255
2.2 FEATURES OF MS WORD 256
2.3 USES OF MS WORD 257
2.4 SUMMARY.....258
2.5 ASSESSMENT QUESTION.....258
2.6 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
3.0 OBJECTIVE 259
3.1 EXCEL SPREADSHEET 259
3.2 FEATURES OF SPREADSHEET 261

3.3 FUNCTIONS OF SPREADSHEET 263
3.4 USES OF SPREADSHEETS 263
3.5 COMPONENTS OF SPREADSHEETS 264
3.6 BEST SPREADHSEET APPLICATIONS 268
3.7 SUMMARY.....268
3.8 ASSESSMENT QUESTION.....269
3.9 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
4.0 OBJECTIVE 270
4.1 PRESENTATION PACKAGE.....270
4.2 FEATURES OF PRESENTATION PACKAGE.....270
4.3 USES OF PRESENTATION PACKAGE.....271
4.4 IDENTIFICATION OF POWERPOINT TOOLBAR AND ITS CONTENTS272
4.5 SUMMARY.....274
4.6 ASSESSMENT QUESTIONS.....274
4.7 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
1.0 OBJECTIVE 275
1.1 INTRODUCTION 275
1.2 OVERVIEW 276
1.3 THE TYPICAL HAZARDS THAT THREATEN THE REGULAR OPERATION OF A COMPUTER.....277
1.4 THE MAINTENANCE PROCEDURE FOR PC 278
1.5 SUMMARY.....280
1.6 ASSESSMENT QUESTIONS.....281
1.7 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
2.0 OBJECTIVE 282
2.1 INTRODUCTION 282
2.2 THE NEED FOR PC UPGRADE.....282
2.3 THE TECHNICAL SPECIFICATION OF PC UPGRADING.....284
2.4 PC LIMITATION AND SCOPE FOR UPGRADING 286
3.8 SUMMARY.....287
3.9 ASSESSMENT QUESTIONS.....287
3.9 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**
3.0 OBJECTIVE 289
3.1 HOW TO REPLACE THE COMPUTER'S CASE.....289
3.2 HOW TO REPLACE THE COMPUTER'S POWER SUPPLY UNIT.....291
3.3 HOW TO REPLACE THE COMPUTER'S MOTHERBOARD 293
3.4 HOW TO REPLACE THE COMPUTER'S CPU 295
3.5 HOW TO REPLACE THE COMPUTER'S MASS STORAGE.....297
3.6 HOW TO REPLACE THE COMPUTER DISPLAY UNIT.....299
3.7 HOW TO REPLACE THE COMPUTER KEYBOARD AND MOUSE 301
3.8 SUMMARY.....304
3.9 ASSESSMENT QUESTIONS.....304
3.9 REFERENCE ..... **ERROR! BOOKMARK NOT DEFINED.**

About the Authors
To get started right away, just tap any placeholder text (such as this) and start typing.

About the Book

View and edit this document in Word on your computer, tablet, or phone. You can edit text; easily insert content such as pictures, shapes, or tables; and seamlessly save the document to the cloud from Word on your Windows, Mac, Android, or iOS device.

“Quote”

"In the era of digital revolution, computer education isn't simply a course; it's a compass. It navigates students through the maze of technology, preparing them to not only comprehend but also to invent and impact the future."

For Student

- *Use styles to easily format your Word documents in no time. For example, this text uses the List Bullet style.*
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Module 1: Introduction to Computer Science

Unit 1: History, Classification & Impact of Computer from 1st Generation to Date

Flow of the Unit

1.0 Objective
1.1 History of Computer
1.2 Classification of Computer
1.3 Computer Evolution
1.4 Components of Computer (Hardware & Software)
1.5 Application Areas of Computer
1.6 Summary
1.7 Assessment Question
1.8 Reference

1.0 Objective

a. Understand the history of computer & it's classification
b. Learn about the creation and growth of computers.
c. Learn about the basic computer of computer
d. Understand the application areas of computers.

1.1 History of Computer

The meaning of the word The old "computer" has evolved over the past two centuries. It was originally in Latin. The word became synonymous with "person who calculates" in the 17th century. The definition of a computer was originally defined by the American Heritage Dictionary (1980) as "a person who calculates" until the mid-20th century, when the Webster Dictionary (1980) gave it. Define a computer as "A programmable electronic device that can store Can recall information and information processing." Computers continue to be connected to human activities. Today, any computer device Whatever can It can be "armed and retrieved" information, whether electrical, programming, or something else. called computer

"A multipurpose machine that processes information according to a set of internal, temporary, or permanent frame instructions" is the definition of a computer given by Techencyclopedia in 2003 Hardware includes the computer itself and all related equipment. We refer to the set of instructions that are taught or executed as "software" or a "program." A program is a complex, well-designed set of instructions that tells a computer how to use a computer. A computer is also defined as a "program." "The contribution of people, machines and great ideas to the development of computers" by Encyclopedia Britannica in 2003. Therefore, a computer is a system. A system is a set of computer parts that work together to achieve a single goal.

“History” refers to past events. The discipline that studies the chronological record of events (such as their impact on a nation or people), based on critical examination of their origins and generally offering explanations. Causation” Encyclopedia Britânica (2003) is how I describe it. “Or study past events.”

1.2 Classification of Computer

Computer equipment can be classified in several ways. It depends on the definition and usage. They can be classified according to the technology produced. Available applications Size or capacity, working age, basic working principles and the type of information available Here are some comprehensive classification strategies.

1.2.1 Classification by Technology

This historical classification was based on the technology behind the processing capabilities. or what the computer actually uses:

i. **Meat:** Before any computer technology was invented, calculations were only possible by humans. Must use fingers, toes, and other parts of the body
ii. **Wood:** When was wood originally used to make abacus? Wood then became a computer. Both Pollini in 1709 and Schickard in 1621 played important roles in this development.
iii. **Metal:** Early Pascal and Thomas computers, as well as production models from companies like Brundswiga and Monroe, all had metal components.
iv. **Electronic components**: Zuse, Aiken, early Stibitz and others. Many others use selective mechanical devices as differential analyzers. These are used by computers with stored programs ABC, ENIAC and Colossus as new types of electronic devices are introduced. many in the last sixty years. This classification is therefore not related to the progress made during that time.

1.2.2 Classification by Capacity

A computer may be classified based on its capability. The "capacity" of a computer denotes its capability to manage a certain volume of work or process data. The computer's memory capacity,

internal processing speed, compatibility with external devices, and software capabilities all influence its operational efficiency.

The physical size of early computers determined their functionality. The volume escalates with augmenting dimensions. Conversely, contemporary computer technology often yields more compact systems, allowing the integration of comparable speed and capacity inside a reduced form factor. Currently, the number of applications a computer can run rather than the quantity of data it can process is used to evaluate its capacity. As a consequence, this classification is carried out as follows:

i. **Micro Computers:** The lowest level of capabilities is found in microcomputers. Typically, silicon chips are used to make semiconductors for use in machine memory. Since 1971, silicon chips have been made on a wide scale, which has tremendously contributed in the production of microcomputers. A microprocessor, random-access memory (RAM), and programmable read-only memory (ROM) are the three components of a microcomputer, which is a digital computer system that is operated by a stored program. RAM is the functional equivalent of computer memory, while ROM gives the instructions that the computer is to obey.

   Microcomputers, such as the Apple IIe, Genie III, and Radio Shack TRS-80, are effectively fourth generation devices. Microcomputers can perform modest, single-business applications like inventory management, payroll processing, invoicing, and sales analysis. They offer 4K to 64K of storage capacity.

ii. **Mini Computers:** The minicomputer was created in the 1960s in response to the rising demand for a more compact, stand-alone device to do jobs that bigger computers could not effectively handle. Compared to microcomputer systems, minicomputers have higher storage space and quicker operating rates. Minicomputer operating systems generally provide virtual storage in addition to multiprogramming. This indicates that numerous programs may execute at once. This sort of computer system is very versatile and may be built bigger to satisfy user requests.

   The memory storage capacity of minicomputers normally varies from 8k to 256k, combined with a reasonably well-established application software. Typical minicomputers include the PDP-8, IBM systems 3, and Honeywell 200 and 1200 computers.

iii. M**edium-sized Computers:** Compared to micro computers, medium-sized computers give faster operating speeds and more storage capacity. Their operating systems offer virtual storage and multiprogramming, and they can accept a large number of high-speed input/output devices. Multiple disk drives may be deployed to enable online access to big data files when required for direct access processing. This makes it feasible to run numerous applications concurrently. Large banks, insurance businesses, and colleges may all profit from the usage of a medium-sized computer since it can support a management information system. Typically, they have memory capacity between 32k and 512k. Three examples of medium-sized computers are the Burroughs 3500 System, IBM System 370, and NCR Century 200 system.

iv. **Large Computers:** Large computers are next to Super Computers and have greater capacity than the Medium-size computers. They generally feature comprehensive control systems with minimum user participation. massive computer system extends from single-processing setups to statewide computer-based networks including generic massive machines. Large computers have storage capacity from 512k to 8192k, and large computers have internal working speeds measured in terms of nanosecond, as contrasted to tiny computers whose speed is measured in terms of microseconds. Expandability to 8 or even 16 million characters is possible with some of these systems. Such characteristics permitmany data processing jobs to be performed simultaneously.

Large computers are generally utilized in government agencies, huge enterprises and computer services firms. They are employed in complicated modeling, or simulation, business operations, product testing, design and engineering work and in the development of space technology. Large computers may function as server systems where several smaller computers can be linked to it to build a communication network.

v. **Super Computers:** The supercomputers are the largest and fastest machines nowadays and they are employed when billion or even trillions of computations are necessary. These devices are utilized in nuclear weapon development, precise weather forecasting and as host processors for local computer and time sharing networks. Super computers have powers well beyond even the usual large-scale systems. Their pace varies from 100 million-instruction-per-second to well over three billion. Because of their scale, supercomputers forfeit a certain level of flexibility. They are consequently not appropriate

for offering a range of user services. For this reason, supercomputers may require the aid of a medium-size general purpose machines (typically termed front-end processor) to execute minor applications or do slower speed or smaller volume activity.

1.2.3 Classification by their Basic Operating Principle

Using this categorization approach, computers may be separated into Analog, Digital and Hybrid systems. They are explained as follows:

i. **Analog Computers:** Analog computers were widely known in the 1940s yet they are now rare. In such computers, numbers to be employed in some computation were represented by physical quantities - such as electrical voltages. According to the Penguin Dictionary of Computers (1970), "an analog computer must be able to accept inputs which vary with respect to time and directly apply these inputs to various devices within the computer which performs the computing operations of additions, subtraction, multiplication, division, integration and function generation...." The computing units of analog computers react instantly to the changes which they detect in the input variables. Analog computers excel at solving differentialequations and are quicker than digital computers.

ii. **Digital Computers:** Most computers nowadays are digital. They represent information discretely and employ a binary (two-step) system that depicts each item of information as a succession of zeroes and ones.

The Pocket Webster School & Office Dictionary (1990) simply describes Digital computers as "a computer using numbers in calculating." Digital computers manipulate most data more readily than analog computers. They are intended to handle data in numerical form and their circuits execute directly the mathematical operations of addition, subtraction, multiplication, and division. Because digital information is distinct, it can be replicated perfectly but it is difficult to create exact duplicates of analog information.

iii. **Hybrid Computers**: These are devices that can act as both analog and digital computers.

1.3 The Computer Evolution

The computer development is undoubtedly an intriguing subject that has been discussed in several different ways throughout the years, by many writers. According to The Computational Science Education Project, US, the computer has gone through the following stages:

1.3.1 The Mechanical Era (1623-1945)

Trying to employ machines to solve mathematical issues may be dated to the early 17th century. Wilhelm Schickhard, Blaise Pascal, and Gottfried Leibnitz were among mathematicians who created and built calculators that were capable of addition, subtraction, multiplication, and division including The earliest multi- purpose or programmable computer device was presumably Charles Babbage's Difference Engine, which was started in 1823 but never finished. In 1842, Babbage developed a more ambitious engine, dubbed the Analytical Engine but regrettably it again was only half constructed. Babbage, coupled with Ada Lovelace identified numerous significant programming methods, including conditional branching, iterative loops and index variables. Babbage created the machine which is perhaps the first to be utilized in computational science. In 1933, George Scheutz and his son, Edvard started work on a smaller version of the difference engine and by 1853 they had created a machine that could analyze 15-digit integers and determine fourth-order differences. The US Census Bureau was one of the first institutions to deploy the mechanical computers which used punch-card technology created by Herman Hollerith to tabulate data for the 1890 census. In 1911 Hollerith's firm amalgamated with a rival to form the organization which in 1924 became International Business Machines (IBM).

1.3.2 First Generation Electronic Computers (1937-1953)

These devices employed electronic switches, in the form of vacuum tubes, instead of electromechanical relays. The first effort to develop an electrical computer was by J. V. Atanasoff, a professor of physics and mathematics at Iowa State in 1937. Atanasoff set out to construct a machine that would assist his graduate students solve systems of partial differential equations. By 1941 he and graduate student Clifford Berry had succeeded in developing a computer that could solve 29 simultaneous equations with 29 unknowns. However, the machine was not programmable, and was more of an electronic calculator.

A second early electronic computer was Colossus, created by Alan Turing for the British military in 1943. The first general purpose programmable electronic computer was the Electronic

Numerical Integrator and Computer (ENIAC), created by J. Presper Eckert and John V. Mauchly at the University of Pennsylvania. Research work started in 1943, supported by the Army Ordinance Department, which sought a technique to calculate ballistics during World War II. The machine was developed in 1945 and it was utilized extensively for computations during the creation of the hydrogen bomb. Eckert, Mauchly, and John von Neumann, a consultant to the ENIAC project, started work on a new computer before ENIAC was done. The fundamental contribution of EDVAC, their new project, was the concept of a stored program. ENIAC was controlled by a series of external switches and knobs; to modify the program required physically adjusting the settings on these controls. EDVAC was able to operate orders of magnitude faster than ENIAC and by storing instructions in the same medium as data, designers could focus on refining the internal structure of the machine without worrying about matching it to the speed of an external control. Eckert and Mauchly subsequently created what was considered the first commercially viable computer, the UNIVAC; in 1952. Software technology at this time was quite basic.

1.3.3 Second Generation (1954-1962)

The second generation experienced various key breakthroughs at all levels of computer system architecture, ranging from the technology used to manufacture the fundamental circuits to the programming languages used to compose scientific applications. Electronic switches in this period were based on discrete diode and transistor technology with a switching time of roughly 0.3 microseconds. The earliest computers to be constructed with this technology are TRADIC at Bell Laboratories in 1954 and TX-0 at MIT's Lincoln Laboratory. Index registers were created for controlling loops and floating point units for computations based on real values.

A variety of high level programming languages were introduced and they include FORTRAN (1956), ALGOL (1958), and COBOL (1959). Important commercial computers of this period include the IBM 704 and its successors, the 709 and 7094. In the 1950s the first two supercomputers were created particularly for numeric processing in scientific applications.

1.3.4 Third Generation (1963-1972)

Technology changes in this generation include the use of integrated circuits (ICs) semiconductor devices with several transistors built into one physical component, semiconductor memories, microprogramming as a technique for efficiently designing complex processors, and the introduction of operating systems and time-sharing. The initial ICs were based on small-scale

integration (SSI) circuits, which had roughly 10 devices per circuit ('chip'), and advanced to the usage of medium-scale integrated (MSI) circuits, which had up to 100 devices per chip. Multilayered printed circuits were created, and core memory was replaced with quicker, solid-state memories.

In 1964, Seymour Cray designed the CDC 6600, which was the first architecture to exploit functional parallelism. By employing 10 different functional units that could run concurrently and 32 independent memory banks, the CDC 6600 was able to accomplish a calculation rate of one million floating point operations per second (Mflops). Five years later, the CDC introduced the 7600, also created by Seymour Cray. The CDC 7600, with its pipelined functional units, is believed to be the first vector processor and was capable of running at 10 Mflops. The IBM 360/91, launched at the same era, was about twice as fast as the CDC 660.

Early in this third generation, Cambridge University and the University of London partnered in the creation of CPL (Combined Programming Language, 1963). CPL was, according to its developers, an effort to capture just the main characteristics of the intricate and sophisticated ALGOL. However, like ALGOL, CPL was huge with numerous features that were hard to master. In an effort at further reduction, Martin Richards of Cambridge devised a subset of CPL called BCPL (Basic Computer Programming Language, 1967). In 1970, Ken Thompson of Bell Labs produced even another reduction of CPL dubbed just B in conjunction with an early iteration of the UNIX operating system. comment)

1.3.5Fourth Generation (1972-1984)

Large-scale integration (LSI, 1000 devices per chip) and very large-scale integration (VLSI, 100,000 devices per chip) were employed in the development of the fourth-generation computers. Whole processors could now fit on a single chip, and for basic systems,mainmemory,and I/O controllers) could fit on one chip. Gate delays lowered to roughly 1 ns per gate. Core memories were replaced with semiconductor memories.

Large main memory like CRAY 2 started to replace the previous high-speed vector processors, such as CRAY 1, CRAY X-MP, and CYBER. In 1972, Dennis Ritchie built the C language from the architecture of the CPL and Thompson's B. Thompson and Ritchie then used C to develop a version of UNIX for the DEC PDP-11. Other breakthroughs in software include extremely high-level languages such as FP (functional programming) and Prolog (programming in logic).

IBM partnered with Microsoft throughout the 1980s to establish what we can genuinely term PC (personal computer) life today. The IBM PC was debuted in October 1981, and it functioned with the operating system software named 'Microsoft Disk Operating System (MS DOS) 1.0. Development of MS DOS started in October 1980 when IBM began exploring the market for an operating system for the then projected IBM PC, and important contributors were Bill Gates, Paul Allen, and Tim Paterson. In 1983, Microsoft Windows was released, and this has experienced various advancements and updates over the subsequent twenty years.

1.3.6 Fifth Generation (1984-1990)

This generation brought to the emergence of computers with hundreds of processors that may all be working on separate sections of a single program. The scale of integration in semiconductors increased at a rapid rate, and by 1990 it was feasible to manufacture circuits with a million components, and semiconductor memory were common on all computers. Computer networks and single-user workstations also grew popular. Parallel processing began in this generation. The Sequent Balance 8000 linked up to 20 processors to a single shared memory module, however each CPU had its own local cache. The machine was planned to compete with the DEC VAX-780 as a general-purpose Unix system, with each CPU working on a distinct user's workload. However, Sequent supplied a library of subroutines that would let programmers to construct programs that would employ more than one processor, and the machine was frequently used to study parallel algorithms and programming approaches. The Intel iPSC-1, often known as 'the hypercube,' linked each CPU to its own memory and utilized a network interface to connect processors. This distributed memory design meant memory was no longer a barrier and huge systems with more processors (as many as 128) could be constructed. Also presented was a machine, known as a data-parallel or SIMD, where there were several thousand extremely basic processors that functioned under the command of a single control unit. Both wide area network (WAN) and local area network (LAN) technologies grew fast.

1.3.7 Sixth Generation (1990 to Date)

Since 1990, the majority of computer system advances have been incremental enhancements to existing systems rather than fundamental upgrades. This generation saw advances in parallel computing, both in hardware and in our knowledge of how to create algorithms to use parallel

systems. Workstation technology advanced, with CPU designs including RISC, pipelining, and parallel processing.

Wide area networks, network capacity, speed of operation, and networking capabilities have all advanced dramatically. Personal computers (PCs) currently employ Gigabit per second CPUs, multi-Gigabyte drives, hundreds of megabytes of RAM, color printers, high-resolution graphic displays, stereo sound cards, and graphical user interfaces. There are thousands of pieces of software (operating systems and applications) available today, and Microsoft Inc. has made significant contributions.

Finally, this generation has introduced microcontroller technology. Microcontrollers are 'embedded' into other devices (often consumer items) to control the product's features or operations. They function as miniature computers inside gadgets and are currently vital components in most machinery.

1.4 Component *of Computer* (Hardware & Software)

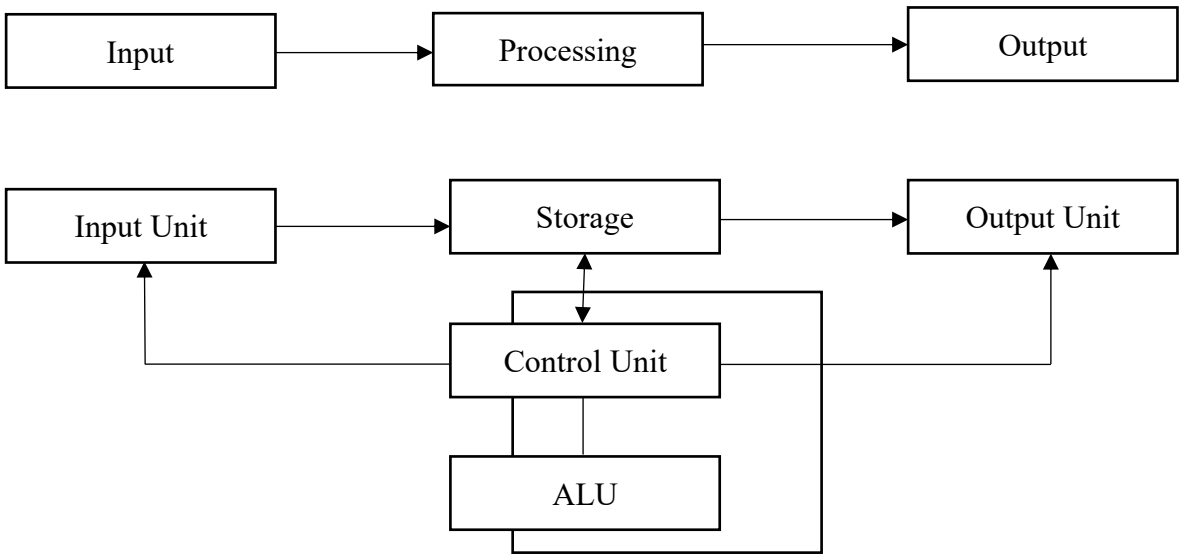


Figure 1.1: Block Diagram of Computer

1.4.1 Components of Computer (Hardware)

A computer can process data, images, audio, and graphics. They can tackle very complex issues rapidly and correctly.

1.4.1.2 Input *Unit*

Computers need data and instructions to solve problems. Thus, we must enter the data and instructions into the computers. The input unit includes one or more input devices. The keyboard is one of the most widely used input devices. Other regularly used input devices include the mouse, floppy disk drive, and magnetic tape.

Keyboard

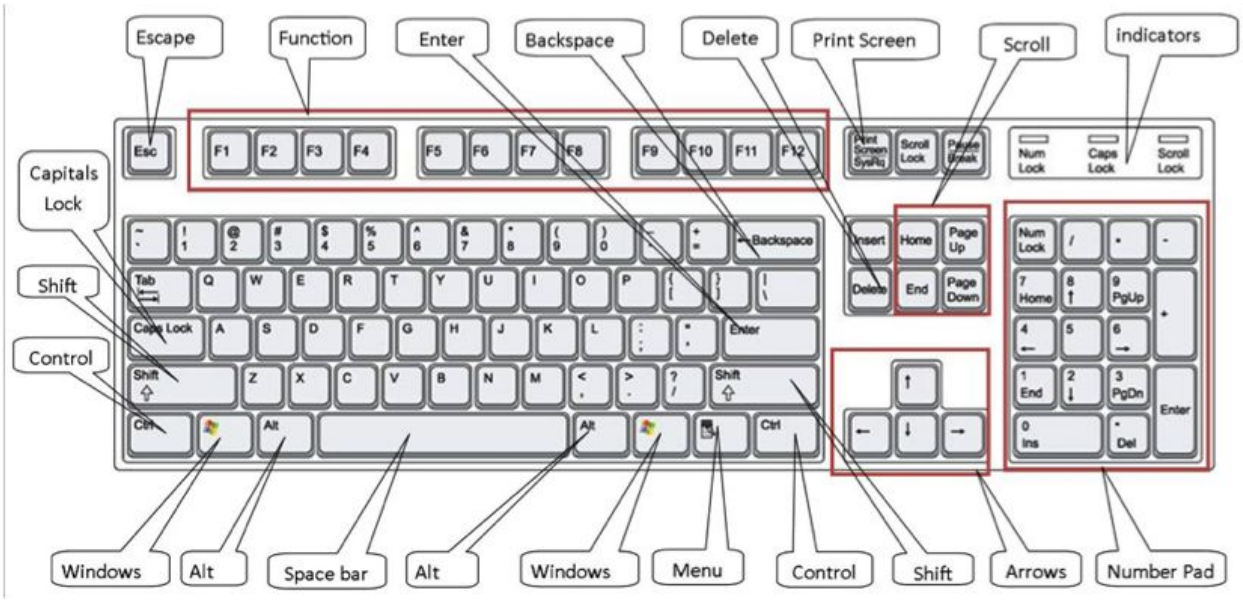


Figure 1.2: *Keyboard Layout*
Source: https://www.digitalunite.com/technology-guides/computer-essentials/using-computer/how-use-computer-keyboard

Mouse

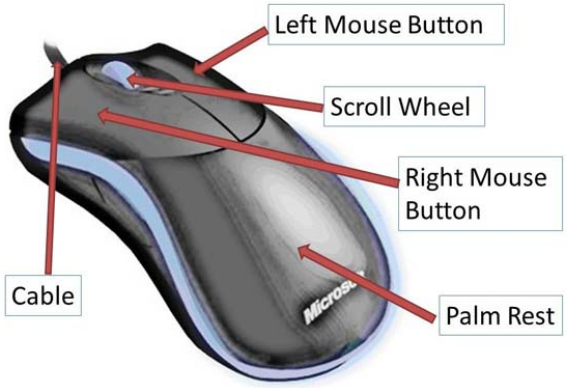


Figure 1.3: *Mouse Layout*
Source: https://software.isrg.org.uk/vipi/downloadedcourse/resources/13.html - mouse source

Magnetic Tape

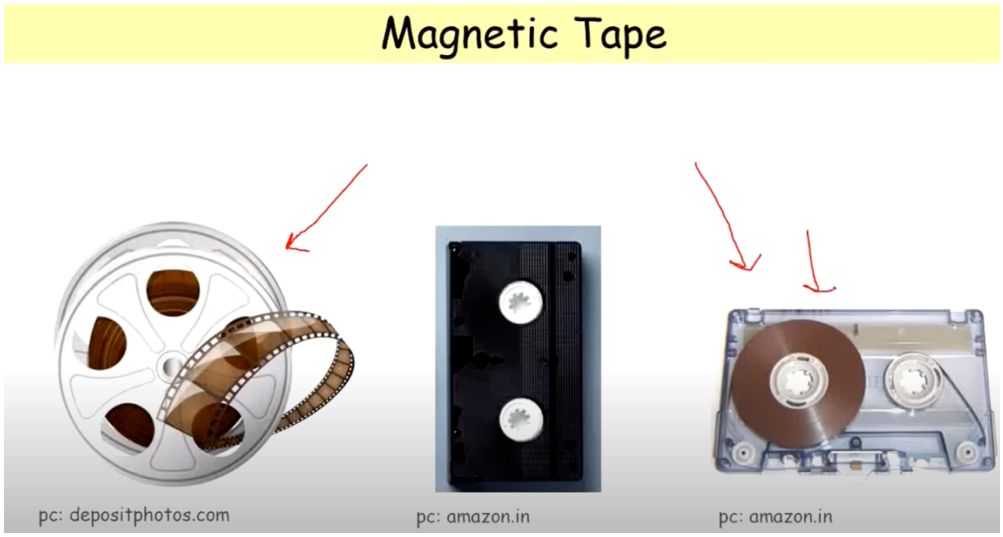


Figure 1.4: *Magnetic Tape*

Floppy Disk Drive

Figure 1.5: *Floppy Disk Drive*
Source: https://pngimg.com/image/104528#google_vignette

Thump drive/Flash

Figure 1.6: *Thump Drive*
Source: https://www.pngwing.com/en/free-png-zswiy/download

All of the input devices fulfill the following functions.

i. Receive external data and instructions.
ii. Convert it to a computer-readable format.
iii. Send the converted data to the computer system for further processing.

1.4.1.2 Storage Unit

The computer's storage unit stores data and instructions from the input unit before processing them. It saves intermediate and final findings before sending them to the output devices. It also stores data for subsequent use.

There are two types of computer storage devices.

a. Primary Storage

Stores and delivers data quickly. This memory is often used to store the program that is now being performed in the computer, the data received from the input unit, and the program's intermediate and final outcomes. The basic memory is just transient in nature. When you turn off your computer, you lose your data. To save data permanently, it must be moved to secondary memory. A very tiny fraction of main storage memory is permanent by nature, such as ROM, which retains data long when the power is turned off.

Primary storage costs more or is comparable to secondary storage. As a result, main storage space on most computers is restricted.

ROM

Figure 1.7: *Computer ROM*
Source: https://maaz.ihmc.us/rid=1SKX0FMZM-L3TY10-1FVC/Memoria-ROM.jpg

b. Secondary Storage

Secondary storage is utilized as an archive. It saves many applications, papers, databases, and so on. Before you can execute a program on a computer, it is first copied to main memory. When the results are saved, they are again stored in secondary memory.

Secondary memory is cheaper and slower than main memory. Hard disks, CDs, and other types of auxiliary memory devices are widely utilized.

Hard Disk

Figure 1.8: Hard Drive
Source: https://www.pngwing.com/en/free-png-zpead/download

CDs

Figure 1.9: *Compact Disc*
Source: https://www.pngwing.com/en/free-png-zpead/download

1.4.1.3 Memory Size

Digital computers employ a binary system of 0's and 1's. Every letter or integer is represented by an 8-bit code.

a. A byte is a collection of eight bits.
b. A single character takes up one byte of space.
c. A numeric occupies two bytes of space.
d. The space occupied in memory is known as a byte.

The main storage capacity is defined in either KB (Kilobytes) or MB. One KB is 1024 bytes, and one MB equals 1000KB. A common PC's main storage begins at 16MB. PCs with 32 MB, 48 MB, 128 MB, and 256 MB RAM are quite popular.

1.4.1.4 Output Input

The computer's output unit transmits calculation results to the outer world. Printers and Visual Display Units (VDUs) are regularly used output devices. Other popular output devices include floppy disk drives, hard disk drives, and magnetic tape drives.

Printer

Figure 1.10: *Printer*
Source: https://www.pngwing.com/en/free-png-hhovu/download

Visual Display Unit

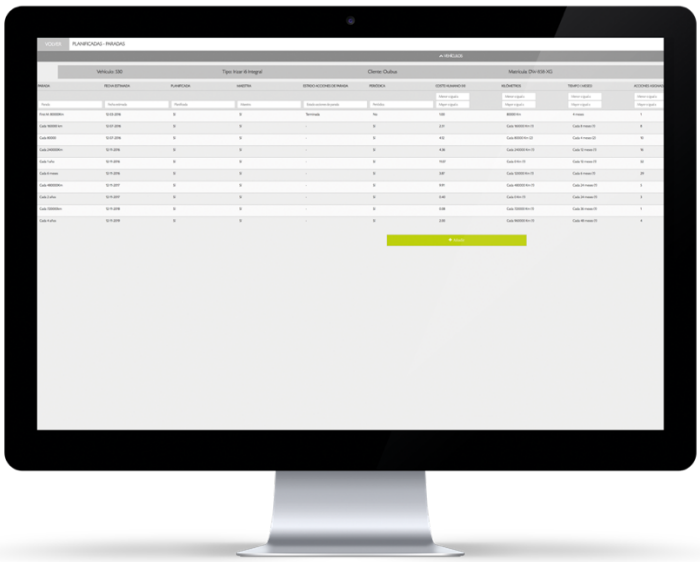


Figure 1.11: *Monitor*

Source: https://www.pngwing.com/en/free-png-puamn/download

The computer's **Arithmetic Logic Unit (ALU)** processes all computations. It also compares and makes decisions. The ALU performs fundamental operations like addition, subtraction, multiplication, and division, as well as logic operations like >, <, =, ', etc. Whenever computations are necessary, the control unit transmits data from the storage unit to the ALU. Once the calculations are completed, the control unit transfers the results to the storage unit before sending them to the output unit for display.

The Control Unit is responsible for managing all other computer components. The control unit informs the input unit on where to store the data received from the user. It directs the flow of data and instructions from the storage unit to the ALU. It also monitors the flow of results from the ALU to the storage unit. The control unit is sometimes referred to as the core nervous system of the computer, which controls and synchronizes its operation.

The Central Processing Unit (CPU) consists of the computer's control unit and ALU. The CPU, like the brain, performs the following functions:

a. It completes all computations.
b. It makes all choices.
c. It regulates all of the computer's components.

A PC may contain CPU-ICs such as Intel 8088, 80286, 80386, 80486, Celeron, Pentium, Pentium Pro, Pentium II, Pentium III, Pentium IV, Dual Core, and AMD.

Intel Processor

Figure 1.12: *Intel Core Xeon CPU*
Source: https://www.pngwing.com/en/free-png-sftuk

AMD Processor

Figure 1.13: Graphics Cards & Video Adapters AMD Radeon Software Crimson Advanced Micro Devices AMD FX
Source: https://www.pngwing.com/en/free-png-pefek/download

1.4.2 Components of Computer (Software)

Your system has three sorts of software: application programs, device drivers, and operating systems. Each sort of software does a totally distinct function, yet all three collaborate closely to accomplish beneficial tasks. While certain special-purpose applications may not fall cleanly into any of these categories, most software does. Programs execute in the memory section of the system. While operating, programs are referred to as processes or jobs. The image below depicts the connection between the various software packages and the hardware.

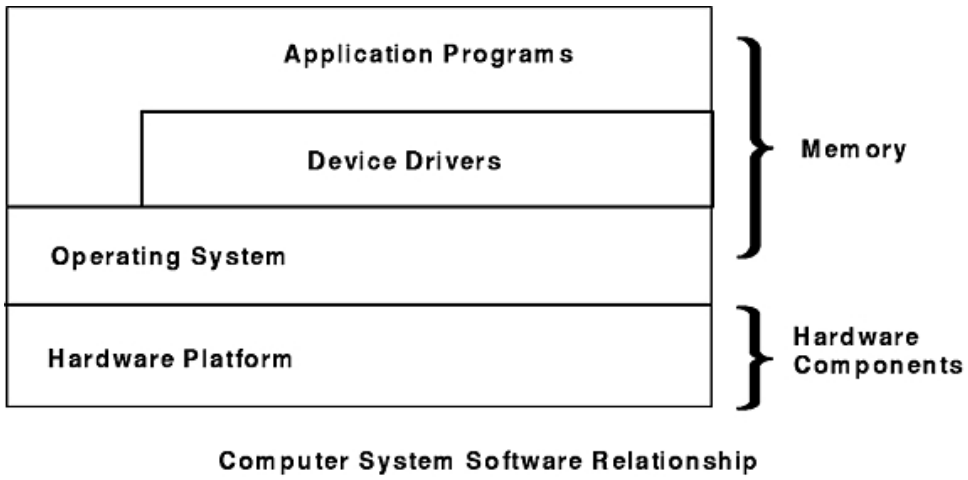


Figure 1.14: Computer System Relationship
Source: https://sites.ualberta.ca/dept/chemeng/AIX-43/share/man/info/C/a_doc_lib/aixuser/aixqbeg/figures/aixqb15.jpg

1. **Application Programs**

The top software layer consists of application applications. These applications let you to execute certain jobs, such as writing with a word processor, accounting with a spreadsheet, and designing with a computer-aided design tool. The remaining two layers, device drivers and the operating system, provide critical support functions. Your system may execute one application software at a time, or many at the same time.

2. **Device Drivers**

Device drivers are extremely specialized applications. Device drivers assist application programs and the operating system in their jobs. Device drivers (specifically, adapters) do not communicate with you. They interface directly with computer hardware pieces, shielding application programs from computer hardware specifications.

3. **Operating System**

An operating system is a collection of programs that manage a computer's resources and govern program execution. These resources are the system's hardware components, which include keyboards, printers, displays, and disk drives. Your AIX operating system includes applications known as commands or utilities that manage your files, transmit and receive messages, and offer system information, among other functions.

An application software uses the operating system to conduct a variety of specific activities related to the computer's internal operations. The operating system also takes direct orders from you for file management and security. There are several extensions to the AIX operating system that enable you to tailor your environment.

4. **Root User Processes**

Root-user processes are applications that can only be executed by users with root privileges. A system administrator has root privileges over all processes.

Root user processes include:

Read and write any item.

Call any system function.

Perform specific subsystem control procedures.

When you are not authorized to perform a command, the system shows a notice stating that you do not have the necessary permissions or are not permitted to run that command. The system administrator may be the only person authorized to log in as root on your system. The system administrator may also configure you to utilize certain commands, giving you some control over processes.

1.5 Application Areas of Computer

1. **Education**

Computers aroften employed in the teaching and learning process. Computer Aided Learning (CAL) and Computer Aided Teaching (CAT) are terms used to describe computer-based learning and teaching. to aid with long-distance learning at universities, often known as the Open University Concept.

Analyze academic data.

2. **Communication Industry**

The combination of computers and telecommunications equipment has greatly accelerated and improved message transmission and reception. They are used in telephone exchanges to switch between incoming and outgoing calls. to transmit and receive electronic communications, such as faxes and e-mails, if linked to a computer network.

3. **Transportation Industry**

Computers are employed for traffic management, such as monitoring vehicles in a congested town. Railroad companies will coordinate the transportation of their products and wagons.

4. **Airports (The Airline Industry)**

Computers are utilized to manage aircraft movement, takeoff, and landing using radar equipment. Making reservations (bookings). Flight information is being stored.

5. **Library services**

Computers may improve library operations by allowing workers to readily access and update records of books and resources, as well as search for titles instead of relying on manual card catalogs.

6. **Domestic and Entertainment Systems**

Home computer usage includes viewing movies, listening to music, and playing computer games to save personal information. For calculating and maintaining household finances in home appliances like microwave ovens, televisions, and so on.

7. **Digital Media**

Digital media, including images and music, has become integral to both our society and research. Certificate students interested in these computer applications may choose to concentrate on one of three broad areas.

Multimedia applications include using computers to create corporate presentations for advertising objectives.

The presentations are done using overhead projectors connected to computers running slide shows and digital video clips captured with a camcorder. The product is described using an overlay voice.Computers are employed in musical instruments such as synthesizers. In entertainment (i.e., games and movies), computers are utilized to integrate stereo sound and digital video clips, making games more realistic.

8. **Graphics**

Courses for a graphics media track may include COS 426 (Computer Graphics), COS 429 (Computer Vision), and COS 436 (Human Computer Interface Technology) or COS 479 (Pervasive Information Systems). The options are many and will vary with the learner. Those interested in pursuing a graphics track for the applications certificate may contact Prof. Adam Finkelstein.

9. **Policy & Intellectual Property**

The legal and political implications of digital media are becoming more relevant in our society.A certificate track focusing on this field could normally include COS 491 (Information Technology and The Law), as well as any of a variety of other potential courses, depending on the student's specific interests.

1.6 Summary

Computer systems are developed in two ways. In one direction, there is technical advancement, while in another, there is a high level of application. Business expectations and demand are increasing. Users are growing increasingly used to its applications, and demand is increasing.

1.7 Self-Assessment Questions

1. Explain the difference between fifth and sixth generation computer systems.
2. Explain the drawbacks of the first generation.
3. Describe the application of computers in education.
4. List the input devices.
5. Differentiate between primary and secondary storage.
6. Write an article about the "evolution of computing."
7. Explain the computer's block diagram in detail. Also, describe the categorization of computers in detail.

Unit 2: Introduction to Computer Data Processing

Flow of the Unit

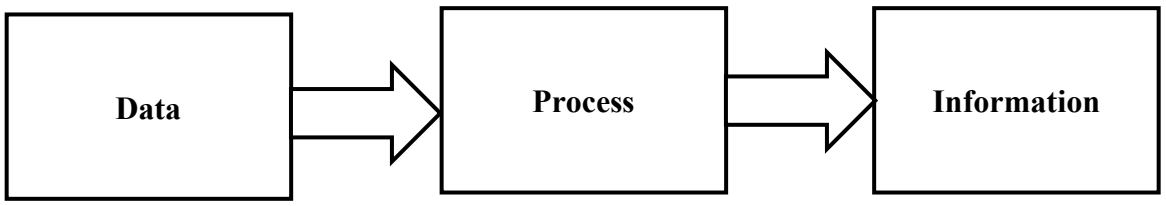
2.0 Objective
2.1 Introduction
2.2 Stages of Data Processing
2.3 Types of Data Processing
2.4 Data Processing Methods
2.5 Summary
2.6 Assessment Question
2.7 Reference

2.0 Objective

a. Understand the overview of Data Processing
b. Learn about the Stages of Data Processing
c. Learn about the Types of Data Processing
d. Understand the Data Processing Methods.

2.1 Introduction

Data processing, or the translation of raw data into useful information, is critical in today's information-rich society. The Data Processing process is critical in many industries, from business and research to real-time applications, affecting how we understand and use information.



2.1.1 What is data processing

Data processing refers to the conversion of data into another format. As we all know, data is quite helpful, and when presented properly, it becomes both enlightening and beneficial. Data processing process systems are also known as information systems. It is equally correct to argue that data processing entails the conversion of information into data and vice versa.

2.1.2 Processing Data versus Processed Data

Processing Data: definition entails establishing and controlling the structure, properties, and specifications of data inside an organisation.

Processed Data: definition often refers to the refined and finished specifications and properties associated with data after different processing procedures.

Processing Data reflects continuous actions to enhance data quality, while processed data is the result of such operations, a refined and structured dataset ready for effective use. Both phases are critical to the data management lifecycle, ensuring the overall effectiveness of data-driven projects and informed decision-making inside businesses.

a. Data processing refers to the conversion of information into a computer-readable format.
b. A computer sorts or processes data.

2.2 Stages of Data Processing

The data processing process consists of a series of steps that turn raw data into relevant information. Here are the six essential steps of the data processing procedure:

1. Collection.

The procedure starts with the collecting of raw data from multiple sources. The stage lays the groundwork for later processing, resulting in a complete pool of data relevant to the planned study. It might involve surveys, sensors, databases, or any other method of acquiring pertinent data.

2. Preparation

Data preparation involves organizing, cleaning, and structuring raw data. Irrelevant information is filtered out, mistakes are repaired, and the data is organized in a manner that allows for efficient analysis in later stages of processing.

3. Input.

During the data entry step, the prepared data is sent to a computer system. This may be accomplished by human input or automated ways, depending on the nature of the data and the systems in place.

4. Data Processing.

The heart of data processing is the manipulation and analysis of prepared data. Sorting, summarizing, calculating, and aggregating are used to obtain useful insights and patterns.

5. Data output.

The findings of data processing are provided in an understandable way at the data output step. This might include reports, charts, graphs, or other visual representations that help people comprehend and make decisions based on examined data.

6. Data Storage

The last step involves saving the processed data for future reference and study. This is critical for keeping a historical record, facilitating rapid retrieval, and supporting existing or future data-related projects. Proper data storage assures the life and availability of critical information.

2.3 Types of Data Processing

There are 7 kinds of Data Processing, outlined below:

1. **Manual Data Processing**

In this form, data is processed by people without the assistance of machines or electrical equipment. It entails duties such as manual computations, sorting, and recording, making it a time-consuming operation.

2. **Mechanical Data Processing**

This kind employs mechanical equipment, such as punch cards or mechanical calculators, to process data. While more efficient than manual processing, it lacks the speed and capability of electronic systems.

3. **Electronic Data Processing**

Electronic Data Processing (EDP) includes the use of computers to process and analyze data. It greatly boosts speed and accuracy compared to manual and mechanical approaches, making it a major change in data processing.

4. **Batch Data Processing**

Batch processing includes arranging data into batches and processing them collectively at a specified time. It is ideal for non-time-sensitive activities and is efficient for large-scale data processing.

5. **Real-time Data Processing**

Real-time processing deals with data instantly as it is created. It is vital for time-sensitive applications, delivering quick replies and updates, commonly found in applications like financial transactions and monitoring systems.

6. **Online Data Processing**

Online Data Processing Online Data Processing (OLTP) includes processing data immediately as it is being acquired. It is interactive and allows concurrent transactions, making it suited for applications that demand simultaneous user involvement and data changes.

7. **Automatic Data Processing**

Automatic Data Processing (ADP) refers to the use of computers and software to automate data processing processes. It comprises numerous approaches, including batch processing and real-time processing, to effectively manage massive amounts of data with minimum human participation.

Examples of Data Processing

a. **Stock markets** handle a tremendous number of data during deals. The system matches buy and sell orders, updates stock prices in real-time, and records transaction information to ensure an accurate and transparent market.
b. In **manufacturing,** data processing is utilized for quality control. Sensors and monitoring devices gather data on manufacturing processes, and algorithms evaluate this information to spot flaws, assuring product quality.
c. **Smart home devices** collect data from sensors and human inputs to execute activities including changing thermostats, controlling lighting, and managing security systems depending on established settings or user preferences.
d. **Electronic Health Records (EHRs)** store and handle patient data in healthcare settings. This contains medical history, test findings, and treatment plans, promoting fast and accurate healthcare delivery.

Advantages of Data Processing

i. Highly efficient
ii. Time-saving High speed
iii. Reduces mistakes

Disadvantages of Data Processing

i. Large power consumption
ii. Occupies enormous memory.
iii. The cost of installation is significant
iv. Wastage of memory

2.4 Data Processing Process Methods

There are three primary data processing techniques - manual, mechanical and electronic.

1. **Manual Data Processing**

Manual data processing depends on human effort to organize and alter data. It includes duties such as sorting, calculating, and recording information without the aid of machinery or electrical equipment. While it is prone to mistakes and time-consuming, manual processing remains essential in instances where human judgment, intuition, or a personal touch is required.

2. **Mechanical Data Processing**

Mechanical data processing includes the use of machinery, such punch cards or mechanical calculators, to manage data. It is an intermediary step between manual and electronic processing, delivering enhanced efficiency over manual processes but lacking the speed and sophistication of electronic systems. This strategy was prevalent before the widespread introduction of computers.

3. **Electronic Data Processing (EDP)**

Electronic data processing uses computers and digital technologies to conduct data-related activities. It has transformed the profession by greatly boosting processing speed, accuracy, and capacity. Electronic data processing comprises multiple methodologies, including batch processing, real-time processing, and online processing, making it a cornerstone of contemporary information management and analysis.

2.4 Summary

Data processing is the backbone of information management, boosting efficiency, accuracy, and decision-making. From old manual techniques to the cutting-edge electronic processing, the development of data processing technologies has revolutionized how we gather, analyze, and store data.

2.5 Assessment Questions

1. Define data processing. How does it differ from information processing?
2. What are the essential components of a computer system? Explain their functions.
3. Discuss the role of intake, processing, output, and storage in data processing.
4. What is the difference between hardware and software? Provide instances of each.

Unit 3: Computer Ethics and Human Issues

Flow of the Unit

3.0 Objective
3.1 Introduction
3.2 Privacy Concerns
3.3 Intellectual Property Right
3.4 Effects on Society
3.5 Summary
3.6 Assessment Question
3.7 Reference

3.0 Objective

a. Understand the concept of Computer Ethics
b. Learn about the Privacy Concerns
c. Learn about the Intellectual Property Right
d. Understand the Effects on Society.

3.1 Introduction

Ethics are a framework of principles and practices that shape individuals' conduct. Adherence to these principles is not rigorously enforced; yet, its observance fundamentally serves the collective welfare. Ethics differ from laws, which officially dictate what is considered right or wrong. Ethics exemplify societal perceptions of good and wrong.

Computer Ethics

Computer ethics provide a framework of moral principles that regulate the use of computers. It pertains to societal perceptions around the use of computers, including both hardware and software. Privacy concerns, intellectual property rights, and repercussions on society are some of the typical topics in computer ethics.

3.2 Privacy Concerns

Hacking is unauthorized access into a computer or a network. A hacker may penetrate the security measures of a computer system or network and gain unauthorized access to other machines.

Malware refers to malicious software designed to compromise a computer system. Common malware includes viruses, spyware, worms, and trojan horses. A virus may erase files from a hard drive while spyware can gather data from a computer.

Data protection, commonly referred to as information privacy or data privacy, is the process of securing data to balance individual privacy rights with the authorization of data use for corporate needs.

Anonymity is a means of keeping a user's identity concealed via numerous apps.

3.3 Intellectual Property Rights

Copyright is a kind of intellectual property that offers proprietary publishing, distribution, and use rights for the author. This implies that whatever concept the author generated cannot be exploited or spread by anybody else without the authorization of the author.

Plagiarism is an act of copying and publishing another person's work without appropriate citation. It's like taking someone else's work and publishing it as your own work.

Cracking is a means of breaking into a system by getting past the security mechanisms of the system. It's a means of avoiding the registration and authentication stages while installing a program.

Software licensing enables the usage of digital information by following the licensing agreement. Ownership stays with the original copyright owner; users are only allowed permissions to use the item depending on the agreement.

3.4 Effects on Society

Jobs other occupations have been discontinued while other tasks have grown easier as computers have taken over organizations and enterprises. Things may now be done with only one click, when previously it took numerous steps to execute a job. This adjustment may be regarded as unethical since it restricts the talents of the workers. There are also ethical worries about the health and safety of workers becoming ill from frequent sitting, gazing at computer displays, and typing on the keyboard or clicking on the mouse.

Environmental Impact: The environment has been damaged by computers and the internet, as so much time spent using computers increases energy consumption, which in turn raises the production of greenhouse gases. There are methods where we can conserve energy, like reducing computer time, shutting off the computer, or putting on sleep mode when not in use. Buying energy-efficient PCs with an Energy Star rating may also help preserve the environment.

Social Impact: Computers and the internet help individuals remain in contact with family and friends. Social networking has become highly popular lately. Computer gaming affects society both favorably and adversely.

- Positive impacts include increased hand-eye coordination, stress alleviation, and improved strategic thinking.
- Negative impacts include addiction to gamers, separation from the real world, and exposure to violence.
- Computer technology assists the government in enhancing services to its residents. Advanced databases can handle vast amounts of data being gathered and processed by the government.
- Computer technology assists organizations by automating procedures, reporting, and analysis.

3.5 Summary

Computer ethics was originally defined by Walter Maner, (1996), a professor at Bowling Green State University. Maner found ethical problems that were brought up during his Medical Ethics course at Old Dominion University become more complicated and challenging when the usage of technology and computers were involved. Bynum, Terrell (2018) The conceptual roots of computer ethics are examined by information ethics, a discipline of philosophical ethics championed, among others, by (Luciano Floridi, 2010)

3.6 Assessment Question

1. Define computer ethics.
2. What is the difference between privacy and anonymity?
3. Explain the notion of intellectual property.
4. What is the digital divide?
5. What are the ethical consequences of artificial intelligence?

Unit 4: Introduction to Information and Communication Technology (ICT)

Flow of the Unit

4.0 Objective
4.1 Introduction
4.2 Components of Information and Communication Technology (ICT)
4.3 Communication Networks
4.4 The principles of ICT
4.5 The Benefits of ICT
4.6 Summary
4.7 Assessment Question
4.8 Reference

4.0 Objective

a. Define information and its qualities.
b. Elucidate the three fundamental elements of information technology.
c. Summarize the fundamentals of business reengineering, highlighting the possible advantages for individuals and organizations.
d. Examine the many possibilities that information technology presents to individuals.

4.1 Introduction

The life wire of today´s commercial organizations, institutions and industries are Information. Information and Communication Technologies (ICT) involves all of the modern we change information and communicate our message to millions. In a broad context, this is the approach for ICT can use to learn along: Understanding 3 major components Information; computers change data into information Communications; networks transfer information Technology Transmission know-how For getting knowledge about just this much you need.

This course, is the Foundation in Information and Communication Technology (ICT) which shall emphasize on how ICT affects a business life-style; even at home. This emphasis will be in the implementation of ICT, being used to solve real world problems and how new an emerging technology are applied in real business organizations as well practice application to both personal and professional; challenges around IT within local or global contexts.;.integration with e learning.

What is Information and Communication Technology (ICT)

Information and communication technologies (ICT) is the ultimate word covering any or all telecommunications, satellite transmission processes; as well as network configuration of intelligent polytronics including processing disciplines to decipher Albanian messages. Sometimes

this term is preferred to Information Technology (IT) or "InfoTech". The phrase was supposedly coined in 1981 by Jim Domsic of Michigan, who wanted a term to replace the then-ubiquitously unpopular expression "data processing."

Information Technology is the processing and dissemination of data utilizing computer hardware and software, telecommunications, and digital electronics. This section is a high-level overview of Information Communications Technology (ICT).

4.2 Components of ICT

ICT three main components are

1. Computers; used to process data into information,
2. Communications networks; transmission of information,
3. Know-how; the technology used for the transmission

Figure 1.15: The focus of Information Technology
Source: (Senn, 2024).

Computers

Computers are electronic systems capable of processing, storing, and presenting data and information. It consists of two components: hardware and software.

i. ***Hardware*** refers to the computer and its supporting equipment.
ii. ***Software:*** A collection of instructions that operate a computer or a communication network.
iii. ***A program*** is a collection of instructions that leads a computer to execute certain activities and create specific outcomes.

iv. ***System:*** A collection of components that collaborate to achieve a goal.

v. ***Data*** refers to raw facts, numbers, and information.

vi. ***Information:*** A structured, understandable, and practical interpretation of data.

vii. ***Knowledge:*** Being aware of and comprehending a collection of information, as well as how to effectively utilize that information.

viii. ***Information System:*** A business information system that generates the information required for the effective management of a structured issue, process, department, or company.

Computers come in four sizes:

- Microcomputers.
- midrange computers
- Mainframes.
- Supercomputers.

Micro-computers: The most prevalent sort of computer is very tiny, and it easily outsells all other types of computers for usage in schools, businesses, and households each year. There are five categories of microcomputers:

- Desktop computers:
- Tower Systems
- Laptop computer.
- Notebook and palmtop computers are two types of computers.

Desktop computers are microcomputers with a display mounted on top of the system unit.

Figure 1.16: Desktop Microcomputers. Source: Google Images (2024).

Tower Systems: These are microcomputers with system units located beside the computer display.

Figure 1.17: A tower system. Source: Google Images (2024).

Laptop Computer: This term refers to microcomputers that are small enough to be placed on a user's lap for operation.

Figure 1.18: shows a laptop computer. Source: Google Images (2024).

Notebook Computer: This term refers to microcomputers that are about the size of a notebook.

Figure 1.19: A notebook PC. Source: Google Images (2024).

Palmtop computers: These are microcomputers that can be placed on top of the user's palms for operation and are also portable. It is also known as Personal Digital Assistant (PDA).

Figure 1.20: shows the Psion Series 3mx Palmtop and small Palmtop computers. Source: Google Images (2024).

Midrange computers and mainframes: A computer connects people and vast amounts of data. A minicomputer is more powerful than a microcomputer and is often specialized to completing certain activities. Examples include IBM 360/370 systems and NCR V-8800 systems.

Supercomputers: The most powerful of all computers, supercomputers were created to handle issues involving lengthy and demanding computations. Example A Cray X-MP Supercomputer

Minicomputers: These were created in the 1970s for certain purposes (i.e., special purpose computers). They are smaller, less powerful, and far less costly than mainframes. Examples include the PDP 11, VAX 750/6000, NCR 9300, DEC, HEWLETT PACKARD 3000, IBM System 38, and MV400.

4.3 Communications Networks

A communications network is a collection of places, or nodes, that are connected as a system to send and receive data and information.

- **Communication:** The transmission and reception of data and information over a communications network.
- **Data Communication:** The transfer of data and information across a communication channel.

3.4 The Principles of Information Technology

A principle is a basic rule, guideline, or driving notion that, when applied to a situation, achieves the intended outcome. The major value of ICT is that it helps solve issues, unlocks creativity, and makes individuals more productive than they would be if they did not utilize ICT in their operations.

The Functions of Information Technology

Information Technology consists of nine (9) primary functions: Capture, Verification, Processing/Manipulation, Storage, Retrieval, Data Update, Reproducing, Transmit/Communication, and Generation.

Capture is the process of keeping precise records of actions. This might be accomplished by documenting data from an event or occurrence in many formats such as sales slips, personnel forms, purchase orders, meters, course registration forms, and so on.

- **Verifying:** This is the activity of verifying or validating data to confirm that it was acquired and recorded accurately.
- **Processing/Manipulation:** The process of converting, analyzing, calculating, and synthesizing any kind of data or information.

- Classifying: This is the process of categorizing data pieces based on their size, kind, customer, and so on.
- Arranging (Sorting): This involves arranging data items in a certain or planned order.
- **Calculating:** This comprises the arithmetic and/or logical manipulation of data, such as calculations to determine employee pay, customer invoices, etc.
- **Summarising:** Reducing facts in a logical manner. For example, the school administrator may only be concerned with the total amount of development levies received out of total school fees.

- **Storage:** This requires depositing data on a storage medium, such as a magnetic disk, from which it may be retrieved when required.
- **Retrieval** requires locating and accessing specified data items from the media in which they were stored for further processing or transfer to another user.
- **Data Update:** This entails making changes to the stored information. Such updates may include inserting new records or modifying certain data elements in an existing record. However, this is normally the exclusive preserve of a class of authorized data consumers.
- **Reproducing** includes copying data from one medium to another or into a different location within the same media. For example, a file of data saved on a magnetic disk may be copied onto another disk or magnetic tape for additional processing or security reasons.
- **Transmission/Communication:** The computerized process of delivering information over a communication network. This involves the transfer of data from one location to another. For example, data may be transmitted from a device to a user in the form of a report or a display on the screen of a computer-controlled terminal.
    - Electronic mail (e-mail)
    - Voice messaging (voicemail)
- **Generation:** The process of arranging information into a usable format, such as numbers, writing, music, or visual images.

3.5 The Benefits of Information Technology

The advantages of ICT include information processing speed, consistency, precision, and dependability, as shown in the figure below.

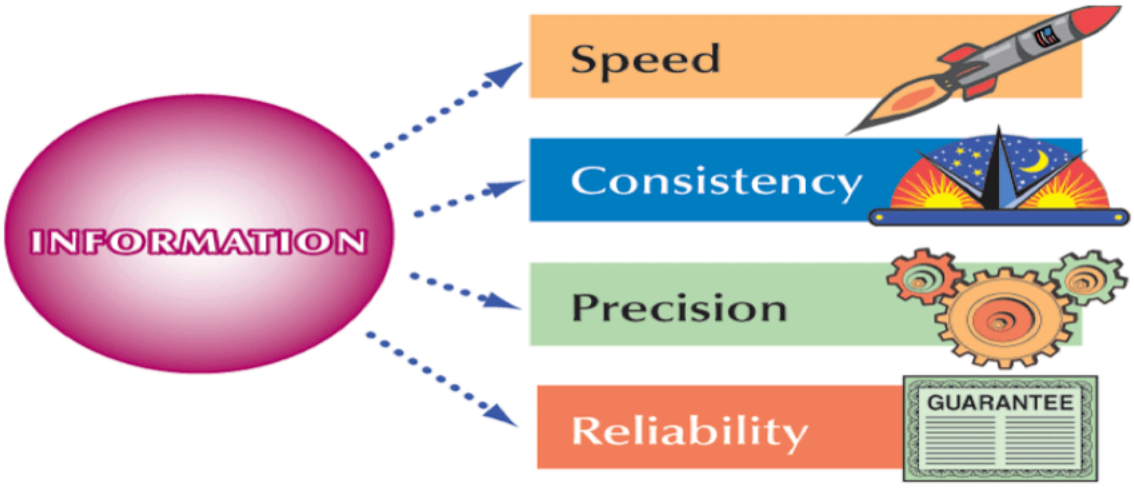


Figure 1.21: The Benefits of Information Technology. (Source: Senn, 2021).

Opportunities of Information Technology

- Helping people and solving problems.
  - Problem: The perceived disparity between an existing and desired state.
  - Problem Solving: The process of recognizing a problem, discovering possible solutions, and effectively applying the selected one.

Information technology enhances our lives in several ways, including print media (newspapers, magazines,

- Posters, and billboards) and electronic media (television, radio, and the internet).
- Education, training, entertainment, shipping, paperwork, finance and investments, agriculture, taxation and accounting, health and medicine, manufacturing, journalism, energy, and sports.

3.6 Summary

Information and communication technology (ICT) is continually changing. Consider the existing applications of digital technology to assist people, companies, and organizations in accessing information.

Understand the process of storing, retrieving, manipulating, transmitting, and receiving digital information. ICT has transformed the globe into a global village.

3.7 Assessment Questions

1. What is Information and Communication Technology (ICT)? List the three major components.
2. List five methods to communicate information. Identify the three phases of information development.
3. Why do we need computers to convert data to information?

Module 2: Introduction to Basic Programming

Unit 1: Introduction to Computer Programming Language (PL)

Flow of the Unit

1.0 Objective
1.1 Introduction
1.2 Language Type
1.3 Business Oriented Languages
1.4 Education Oriented Languages
1.5 WWW Display Language
1.6 Summary
1.7 Assessment Question
1.8 Reference

1.0 Objective

a. Describe PLs.
b. Discuss the languages types.
c. Summarize the fundamentals of all programming languages .

1.1 Introduction

Any of the many languages used to describe a set of comprehensive instructions for a digital computer is known as a computer programming language. When such instructions are written in machine language, a numerical format specific to a particular computer manufacturer, they may be performed immediately; when they are written in a related assembly language, they can be translated from a "higher-level" language, or they can be executed after a straightforward replacement procedure. Relatively few computer languages are extensively used, despite the fact that there are many.

Machine and assembly languages are "low-level," which means a programmer must directly handle all of a computer's unique data storage and operating capabilities. High-level languages, on the other hand, free a programmer from such concerns and give a notation that programmers can write and read with more ease.

1.2 Language Types

1.2.1 Machine and assembly languages.

A machine language is made up of numeric codes that represent the actions that a certain computer can do directly. The codes are strings of 0s and 1s, also known as binary digits ("bits"), that are routinely transformed to and from hexadecimal (base 16) for human reading and alteration. Machine language instructions often employ certain bits to describe operations, such as addition,

and others to represent operands or maybe the position of the next instruction. Machine language is difficult to read and write since it is unlike traditional mathematical notation or human language, and its codes differ from computer to computer.

Assembly language is a step above machine language. It employs short mnemonic codes for instructions and allows the programmer to specify sections of memory that store data. For example, to add two numbers, one may write "add pay, total" instead of "0110101100101000".

Assembly language is intended to be readily converted into machine language. Although data blocks can be referred to by name rather than machine address, assembly language does not allow a more sophisticated way to organize complicated information. Assembly language, like machine language, demands a thorough understanding of internal computer architecture. It is beneficial when such details are required, such as when programming a computer to communicate with peripheral devices (printers, scanners, storage devices, and so on).

1.2.2 Algorithmic languages

Algorithmic languages are intended to represent mathematical or symbolic calculations. They may describe algebraic operations in mathematical notation and employ subprograms to bundle widely used operations for reuse. They were the first higher-level languages.

1.2.3 FORTRAN

The first significant algorithmic language was FORTRAN (formula translation), created in 1957 by an IBM team led by John Backus. It was designed for scientific computations involving real numbers and groups of them structured into one- or multidimensional arrays. Its control structures contained conditional IF statements, repeating loops (known as DO loops), and a GOTO command that enabled nonsequential execution of computer code. FORTRAN makes it easy to have subprograms for common mathematical operations and create libraries of them.

FORTRAN was also intended to transform into an efficient machine language. It was an immediate success and continues to grow.

1.2.3 ALGOL

During 1958-60, a group of American and European computer scientists developed ALGOL (algorithmic language) for publishing algorithms and calculations. ALGOL, like LISP (explained in the following section), contained recursive subprograms procedures that could be invoked to solve an issue by reducing it to a smaller, similar problem. ALGOL introduced the block structure, in which a program is made up of blocks that can contain both data and instructions and have the

same structure as the whole program. Block structure became an effective method for creating complex programs from tiny components.

Backus-Naur Form, a notation developed by ALGOL to describe the structure of a programming language, became the standard tool for defining the syntax (grammar) of programming languages. ALGOL was extensively used in Europe and remained the language of choice for publishing computer algorithms for many years. Many major languages, including Pascal and Ada (both discussed later), are its offspring.

1.2.4 C Programming Language

Dennis Ritchie and Brian Kernighan of AT&T Corporation created the C programming language in 1972 for the purpose of designing computer operating systems. Its ability to arrange data and programs using smaller units is akin to that of ALGOL. It employs a concise notation and allows the programmer to work with both data addresses and values. This capacity is vital in system programming, because C, like assembly language, has the ability to leverage all aspects of a computer's underlying architecture. C, along with its offspring C++, is one of the most widely used languages.

1.3 Business-Oriented Languages.

1.3.1 COBOL

COBOL (common business-oriented language) has been widely used by corporations since its beginnings in 1959. CODASYL (group on Data platforms and Languages) was formed by a group of computer manufacturers and users, as well as government agencies in the United States, to design and supervise the language standard, ensuring its portability across varied platforms.

COBOL uses an English-like notation novel when introduced. Business computations organize and manipulate large quantities of data, and COBOL introduced the record data structure for such tasks. A record clusters heterogeneous data such as a name, an ID number, an age, and an address into a single unit. This contrasts with scientific languages, in which homogeneous arrays of numbers are common. Records are an important example of “chunking” data into a single object, and they appear in nearly all modern languages.

1.3.2 SQL

SQL (structured query language) is a language for organizing databases. Databases organized with SQL are referred to as relational because SQL allows you to query a database for information that fits within a certain relation. For example, a query may be "find all records with both last name

Smith and city New York." Commercial database programs typically employ a SQL-like language for their queries.

1.4 Education-Oriented Languages

1.4.1 BASIC

BASIC (beginner's all-purpose symbolic instruction code) was designed at Dartmouth College in the mid-1960s by John Kemeny and Thomas Kurtz. It was intended to be easy to learn by novices, particularly non-computer science majors, and to run well on a time-sharing computer with many users. It had simple data structures and notation, and it was interpreted: a BASIC program was translated line-by-line and executed as it was translated, which made it easy to locate programming errors.

Its small size and simplicity also made BASIC a popular language for early personal computers. Its recent forms have adopted many of the data and control structures of other contemporary languages, which makes it more powerful but less convenient for beginners.

1.4.2 Pascalz

About 1970 Niklaus Wirth of Switzerland designed Pascal to teach structured programming, which emphasized the orderly use of conditional and loop control structures without GOTO statements. Although Pascal resembled ALGOLin notation, it provided the ability to define data types with which to organize complex information, a feature beyond the capabilities of ALGOL as well as FORTRAN and COBOL. User-defined data types allowed the programmer to introduce names for complex data, which the language translator could then check for correct usage before running a program.

During the late 1970s and '80s, Pascal was one of the most widely used languages for programming instruction. It was available on nearly all computers, and, because of its familiarity, clarity, and security, it was used for production software as well as for education.

1.4.3 Logo

Logo originated in the late 1960s as a simplified LISP dialect for education; Seymour Papert and others used it at MIT to teach mathematical thinking to schoolchildren. It had a more conventional syntax than LISP and featured "turtle graphics," a simple method for generating computer graphics. (The name came from an early project to program a turtlelike robot.) Turtle graphics used body-centred instructions, in which an object was moved around a screen by commands, such as "left 90" and "forward," that specified actions relative to the current position and orientation of

the object rather than in terms of a fixed framework. Together with recursive routines, this technique made it easy to program intricate and attractive patterns.

1.4.4 Hypertalk

Hypertalk was designed as "programming for the rest of us" by Bill Atkinson for Apple's Macintosh. Using a simple English-like syntax, Hypertalk enabled anyone to combine text, graphics, and audio quickly into "linked stacks" that could be navigated by clicking with a mouse on standard buttons supplied by the program. Hypertalk was particularly popular among educators in the 1980s and early '90s for classroom multimedia presentations. Although Hypertalk had many features of object-oriented languages (described in the next section), Apple did not develop it for other computer platforms and let it languish; as Apple's market share declined in the 1990s, a new cross-platform way of displaying multimedia left Hypertalk all but obsolete (see the section World Wide Web display languages).

1.4.5 Object-oriented languages

Object-oriented languages help to manage complexity in large programs. Objects package data and the operations on them so that only the operations are publicly accessible and internal details of the data structures are hidden. This information hiding made large-scale programming easier by allowing a programmer to think about each part of the program in isolation. In addition, objects may be derived from more general ones, "inheriting" their capabilities. Such an object hierarchy made it possible to define specialized objects without repeating all that is in the more general ones. Object-oriented programming began with the Simula language (1967), which added information hiding to ALGOL. Another influential object-oriented language was Smalltalk (1980), in which a program was a set of objects that interacted by sending messages to one another.

1.4.6 C++

The C++ language, developed by Bjarne Stroustrup at AT&T in the mid-1980s, extended C by adding objects to it while preserving the efficiency of C programs. It has been one of the most important languages for both education and industrial programming. Large parts of many operating systems were written in C++. C++, along with Java, has become popular for developing commercial software packages that incorporate multiple interrelated applications. C++ is considered one of the fastest languages and is very close to low-level languages, thus allowing complete control over memory allocation and management. This very feature and its many other capabilities also make it one of the most difficult languages to learn and handle on a large scale.

1.4.7 C#

C# (pronounced C sharp like the musical note) was developed by Anders Hejlsberg at Microsoft in 2000. C# has a syntax similar to that of C and C++ and is often used for developing games and applications for the Microsoft Windows operating system.

1.4.8 ADA

Ada was named for Augusta Ada King, countess of Lovelace, who was an assistant to the 19th-century English inventor Charles Babbage and is sometimes called the first computer programmer. Ada, the language, was developed in the early 1980s for the U.S. Department of Defense for large-scale programming. It combined Pascal-like notation with the ability to package operations and data into independent modules. Its first form, Ada 83, was not fully object-oriented, but the subsequent Ada 95 provided objects and the ability to construct hierarchies of them. While no longer mandated for use in work for the Department of Defense, Ada remains an effective language for engineering large programs.

1.4.9 Java

In the early 1990s, Java was designed by Sun Microsystems, Inc., as a programming language for the World Wide Web (WWW). Although it resembled C++ in appearance, it was object-oriented. In particular, Java dispensed with lower-level features, including the ability to manipulate data addresses, a capability that is neither desirable nor useful in programs for distributed systems. In order to be portable, Java programs are translated by a Java Virtual Machine specific to each computer platform, which then executes the Java program. In addition to adding interactive capabilities to the Internet through Web “applets,” Java has been widely used for programming small

and portable devices, such as mobile telephones.

1.4.10 Visual Basic

Visual Basic was developed by Microsoft to extend the capabilities of BASIC by adding objects and “event-driven” programming: buttons, menus, and other elements of graphical user interfaces (GUIs). Visual Basic can also be used within other Microsoft software to program small routines. Visual Basic was succeeded in 2002 by Visual Basic.NET, a vastly different language based on C#, a language with similarities to C++.

1.4.11 Python

The open-source language Python was developed by Dutch programmer Guido van Rossum in 1991. It was designed as an easy-to-use language, with features such as using indentation instead of brackets to group statements. Python is also a very compact language, designed so that complex jobs can be executed with only a few statements. In the 2010s, Python became one of the most popular programming languages, along with Java and JavaScript.

1.4.12 Declarative languages

Declarative languages, also called nonprocedural or very high level, are programming languages in which (ideally) a program specifies what is to be done rather than how to do it. In such languages there is less difference between the specification of a program and its implementation than in the procedural languages described so far. The two common kinds of declarative languages are logic and functional languages. Logic programming languages, of which PROLOG (programming in logic) is the best known, state a program as a set of logical relations (e.g., a grandparent is the parent of a parent of someone). Such languages are similar to the SQLdatabase language. A program is executed by an "inference engine" that answers a query by searching these relations systematically to make inferences that will answer a query. PROLOG has been used extensively in natural language processing and other AI programs.

Functional languages have a mathematical style. A functional program is constructed by applying functions to arguments. Functional languages, such as LISP, ML, and Haskell, are used as research tools in language development, in automated mathematical theoremproving, and in some commercial projects.

1.4.13 Scripting languages

Scripting languages are sometimes called little languages. They are intended to solve relatively small programming problems that do not require the overhead of data declarations and other features needed to make large programs manageable. Scripting languages are used for writing operating system utilities, for special-purpose file-manipulation programs, and, because they are easy to learn, sometimes for considerably larger programs.

1.4.14 Perl

Perl was developed in the late 1980s, originally for use with the UNIX operating system. It was intended to have all the capabilities of earlier scripting languages. Perl provided many ways to state common operations and thereby allowed a programmer to adopt any convenient style. In the 1990s it became popular as a system-programming tool, both for small utility programs and for prototypes of larger ones. Together with other languages discussed below, it also became popular for programming computer Web "servers."

1.5 World Wide Web Display Languages

1.5.1 HTML

The World Wide Web is a system for displaying text, graphics, and audio retrieved over the Internet on a computer monitor. Each retrieval unit is known as a Web page, and such pages frequently contain "links" that allow related pages to be retrieved. HTML (hypertext markup language) is the markup language for encoding Web pages. It was designed by Tim Berners-Lee at the CERN nuclear physics laboratory in Switzerland during the 1980s and is defined by an SGML DTD. HTML markup tags specify document elements such as headings, paragraphs, and tables. They mark up a document for display by a computer program known as a Web browser. The browser interprets the tags, displaying the headings, paragraphs, and tables in a layout that is adapted to the screen size and fonts available to it.

HTML documents also contain anchors, which are tags that specify links to other Web pages. An anchor has the form <A HREF= "http://www.britannica.com"> Encyclopædia Britannica</A>, where the quoted string is the URL (uniform resource locator) to which the link points (the Web "address") and the text following it is what appears in a Web browser, underlined to show that it is a link to another page. What is displayed as a single page may also be formed from multiple URLs, some containing text and others graphics.

1.5.2 XML

HTML does not allow one to define new text elements; that is, it is not extensible. XML (extensible markup language) is a simplified form of SGML intended for documents that are published on the Web. Like SGML, XML uses DTDs to define document types and the meanings of tags used in them. XML adopts conventions that make it easy to parse, such as that document entities are

marked by both a beginning and an ending tag, such as <BEGIN>…</BEGIN>. XML provides more kinds of hypertext links than HTML, such as bidirectional links and links relative to a document subsection.

1.5.3 Web scripting

Web pages marked up with HTML or XML are largely static documents. Web scripting can add information to a page as a reader uses it or let the reader enter information that may, for example, be passed on to the order department of an online business. CGI (common gateway interface) provides one mechanism; it transmits requests and responses between the reader's Web browser and the Web server that provides the page. The CGI component on the server contains small programs called scripts that take information from the browser system or provide it for display. A simple script might ask the reader's name, determine the Internet address of the system that the reader uses, and print a greeting. Scripts may be written in any programming language, but because they are generally simple text-processing routines, scripting languages like PERL are particularly appropriate.

1.5.4 VB Script

VB Script is a subset of Visual Basic. Originally developed for Microsoft's Office suite of programs, it was later used for Web scripting as well. Its capabilities are similar to those of JavaScript, and it may be embedded in HTML in the same fashion.

Behind the use of such scripting languages for Web programming lies the idea of component programming, in which programs are constructed by combining independent, previously written components without any further language processing. JavaScript and VBScript programs were designed as components that may be attached to Web browsers to control how they display information.

1.6 Summary

Formal languages made of a collection of instructions capable of producing many types of output including software programs, algorithms, and data processing computer programming languages They let developers interact with computers to apply features and find solutions for difficulties. Programming languages fall between low-level languages (like Assembly and machine code) that are closer to the hardware and high-level languages (like Python, Java, and C++) that are more

abstract and simpler for humans to grasp. Every language includes syntax, semantics, and use cases; thus, the choice of a programming language usually relies on the performance concerns, application needs, and developer preferences.

1.7 Assessment Questions

1. Define the difference between high-level and low-level programming languages.
2. List three examples of high-level programming languages and one key feature of each.
3. What is the purpose of a compiler in programming?
4. How do programming languages evolve over time? Provide an example of a programming language that has changed significantly.

Module 2: Introduction to Basic Programming

Unit 2: Concepts of Algorithm, Flowchart and Pseudocode

Flow of the Unit

2.0 Objective
2.1 Introduction
2.2 Algorithm
2.3 Flowchart
2.4 Pseudocode
2.5 Summary
2.6 Assessment Question
2.6 Reference

2.0 Objective

a. Describe different type of algorithm.
b. Write simple algorithm with flowchart.
c. Identify different types of algorithms, flowchart and pseudocode.
d. Identify concept of basic programming
e. Full understanding of basic applications
f. Describe SDLC and its concepts

2.1 Introduction

The algorithm and flowchart are two types of tools to explain the process of a program. In this page, we discuss the differences between an algorithm and a flowchart and how to create a flowchart to illustrate the algorithm visually. Algorithms and flowcharts are two different tools that are helpful for creating new programs, especially in computer programming. An algorithm is a step-by-step analysis of the process, while a flowchart explains the steps of a program in a graphical way.

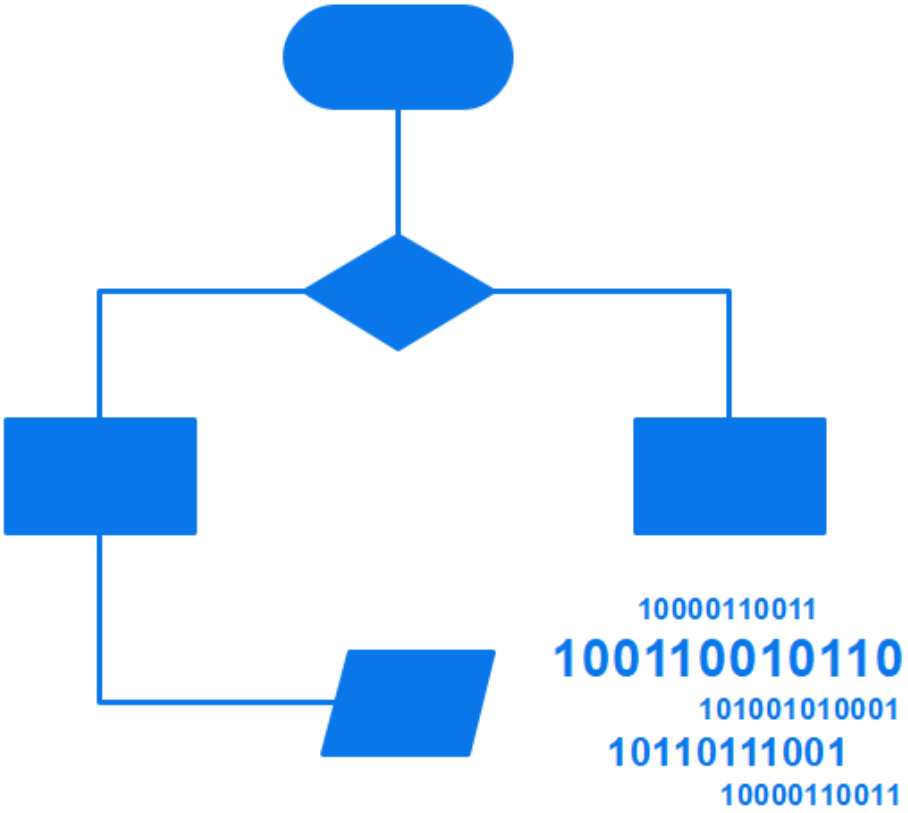
Definition of Algorithm

Writing a logical step-by-step method to solve the problem is called the algorithm. In other words, an algorithm is a procedure for solving problems. In order to solve a mathematical or computer problem, this is the first step in the process.

An algorithm includes calculations, reasoning, and data processing. Algorithms can be presented by natural languages, pseudocode, and flowcharts, etc.

Definition of Flowchart: Algorithm and Flowchart

A flowchart is a graphical depiction of an algorithm using various symbols, shapes, and arrows to illustrate a process or program. Algorithms provide a comprehensive understanding of a program.



The primary objective of using a flowchart is to evaluate several methodologies. Several standard symbols are employed in a flowchart:

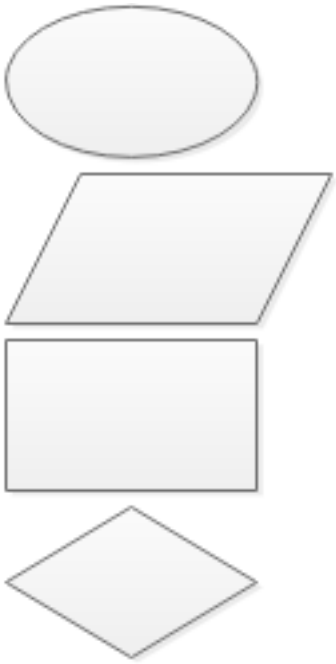
Common Abbreviations Utilized in P&ID

Terminal Box - Start / End

Input / Output

Process / Instruction

Decision



Connector / Arrow

The icons above indicate distinct components of a flowchart. The process in a flowchart may be depicted using boxes and arrows with varied sizes and colors. In a flowchart, we may simply identify key sections and the links between each portion.

Difference between Algorithm and Flowchart

If you equate a flowchart to a movie, then an algorithm is the tale of that movie. In other terms, an algorithm is the heart of a flowchart. Actually, in the world of computer programming, there are many variations between algorithm and flowchart addressing different factors, such as the correctness, the way they present, and the way people feel about them. Below is a table demonstrating the differences between them in detail.

Algorithm

- It is a procedure for solving problems.
- The process is shown in step-by-step instruction.
- It is complex and difficult to understand.
- It is convenient to debug errors.
- The solution is showcased in natural language.
- It is somewhat easier to solve complex problem.
- It costs more time to create an algorithm.

Flowchart

- It is a graphic representation of a process.
- The process is shown in block-by-block information diagram.
- It is intuitive and easy to understand.
- It is hard to debug errors.
- The solution is showcased in pictorial format.

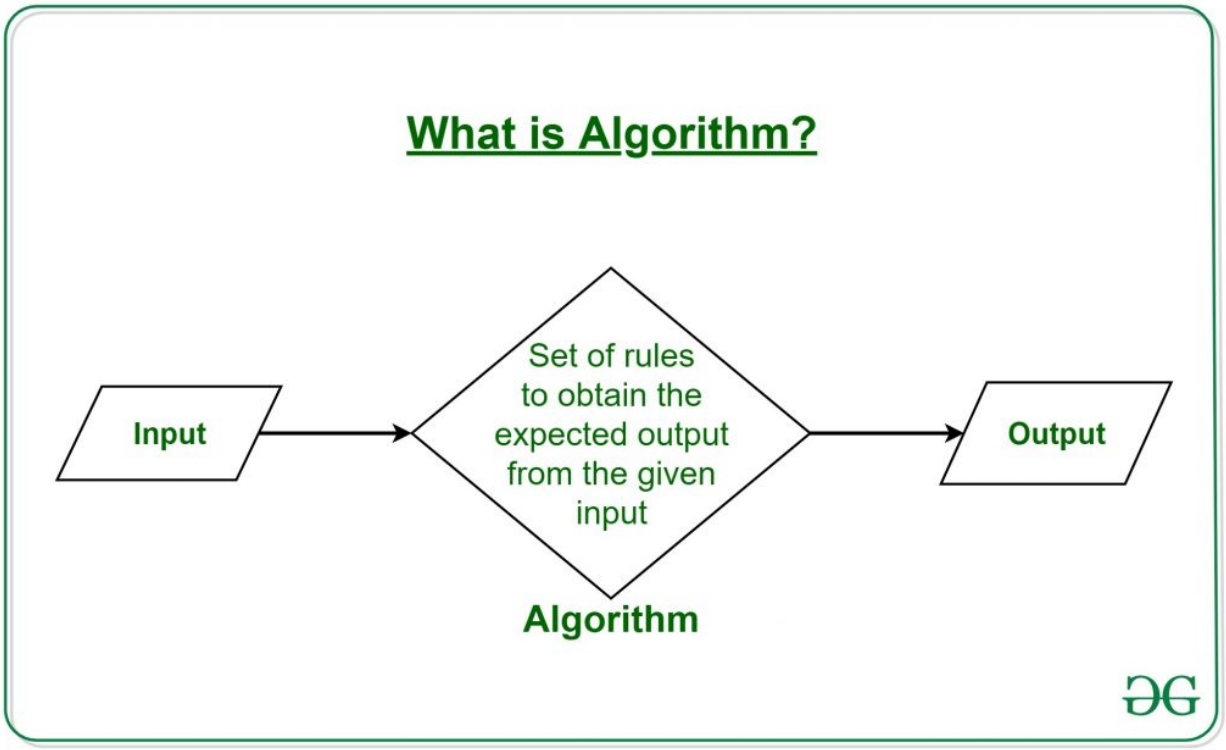
- It is hard to solve complex problem.
- It costs less time to create a flowchart.

2.2 Algorithm

Definition

The word **Algorithm** means ” A set of finite rules or instructions to be followed in calculations or other problem-solving operations ”
Or
” A procedure for solving a mathematical problem in a finite number of steps that frequently involves recursive operations”.

Therefore Algorithm refers to a sequence of finite steps to solve a particular problem.



Source: *https://www.geeksforgeeks.org/introduction-to-algorithms/*

Use of the Algorithms:

Algorithms play a crucial role in various fields and have many applications. Some of the key areas where algorithms are used include:

1. **Computer Science:** Algorithms form the basis of computer programming and are used to solve problems ranging from simple sorting and searching to complex tasks such as artificial intelligence and machine learning.
2. **Mathematics:** Algorithms are used to solve mathematical problems, such as finding the optimal solution to a system of linear equations or finding the shortest path in a graph.
3. **Operations Research:** Algorithms are used to optimize and make decisions in fields such as transportation, logistics, and resource allocation.
4. **Artificial Intelligence:** Algorithms are the foundation of artificial intelligence and machine learning, and are used to develop intelligent systems that can perform tasks such as image recognition, natural language processing, and decision-making.
5. **Data Science:** Algorithms are used to analyze, process, and extract insights from large amounts of data in fields such as marketing, finance, and healthcare.

These are just a few examples of the many applications of algorithms. The use of algorithms is continually expanding as new technologies and fields emerge, making it a vital component of modern society. Algorithms can be simple and complex depending on what you want to achieve. It can be understood by taking the example of cooking a new recipe. To cook a new recipe, one reads the instructions and steps and executes them one by one, in the given sequence. The result thus obtained is the new dish is cooked perfectly. Every time you use your phone, computer, laptop, or calculator you are using Algorithms. Similarly, algorithms help to do a task in programming to get the expected output. The Algorithm designed are language-independent, i.e. they are just plain instructions that can be implemented in any language, and yet the output will be the same, as expected.

What is the need for algorithms?

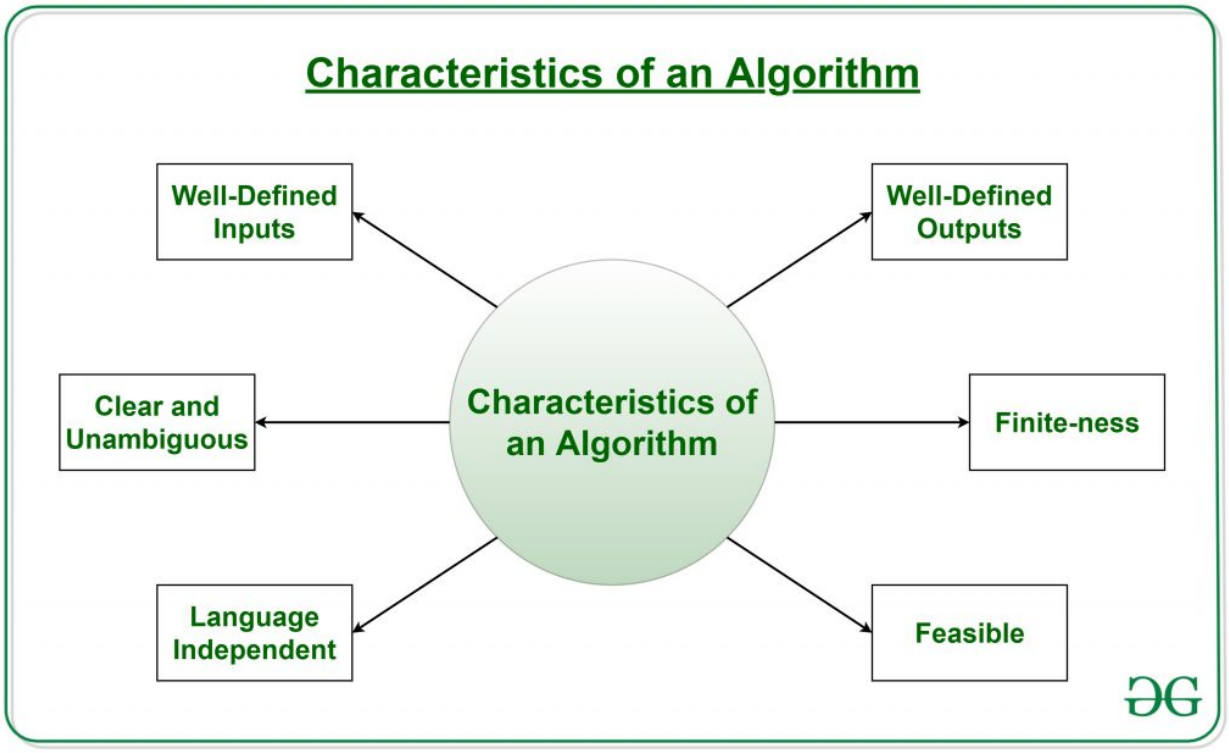
Algorithms are necessary for solving complex problems efficiently and effectively.

They help to automate processes and make them more reliable, faster, and easier to perform.

Algorithms also enable computers to perform tasks that would be difficult or impossible for humans to do manually.

They are used in various fields such as mathematics, computer science, engineering, finance, and many others to optimize processes, analyze data, make predictions, and provide solutions to problems.

Characteristics of an Algorithm



Source: *https://www.geeksforgeeks.org/introduction-to-algorithms*

As one would not follow any written instructions to cook the recipe, but only the standard one. Similarly, not all written instructions for programming are an algorithm. For some instructions to be an algorithm, it must have the following characteristics:

Clear and Unambiguous: The algorithm should be unambiguous. Each of its steps should be clear in all aspects and must lead to only one meaning.

Well-Defined Inputs: If an algorithm says to take inputs, it should be well-defined inputs. It may or may not take input.

Well-Defined Outputs: The algorithm must clearly define what output will be yielded and it should be well-defined as well. It should produce at least 1 output.

Finite-ness: The algorithm must be finite, i.e. it should terminate after a finite time.

Feasible: The algorithm must be simple, generic, and practical, such that it can be executed with the available resources. It must not contain some future technology or anything.

Language Independent: The Algorithm designed must be language-independent, i.e. it must be just plain instructions that can be implemented in any language, and yet the output will be the same, as expected.

Input: An algorithm has zero or more inputs. Each that contains a fundamental operator must accept zero or more inputs.

Output: An algorithm produces at least one output. Every instruction that contains a fundamental operator must accept zero or more inputs.

Definiteness: All instructions in an algorithm must be unambiguous, precise, and easy to interpret. By referring to any of the instructions in an algorithm one can clearly understand what is to be done. Every fundamental operator in instruction must be defined without any ambiguity. Finiteness: An algorithm must terminate after a finite number of steps in all test cases. Every instruction which contains a fundamental operator must be terminated within a finite amount of time. Infinite loops or recursive functions without base conditions do not possess finiteness. Effectiveness: An algorithm must be developed by using very basic, simple, and feasible operations so that one can trace it out by using just

Properties of Algorithm:

a. It should terminate after a finite time.
b. It should produce at least one output.
c. It should take zero or more input.
d. It should be deterministic means giving the same output for the same input case.
e. Every step in the algorithm must be effective i.e. every step should do some work.

Types of Algorithms:

There are several types of algorithms available. Some important algorithms are:

1. **Brute Force Algorithm:**

   It is the simplest approach to a problem. A brute force algorithm is the first approach that comes to finding when we see a problem.

2. **Recursive Algorithm:**

   A recursive algorithm is based on recursion. In this case, a problem is broken into several sub parts and called the same function again and again.

3. **Backtracking Algorithm:**

   The backtracking algorithm builds the solution by searching among all possible solutions. Using this algorithm, we keep on building the solution following criteria. Whenever a

solution fails we trace back to the failure point build on the next solution and continue this process till we find the solution or all possible solutions are looked after.

4. **Searching Algorithm:**

   Searching algorithms are the ones that are used for searching elements or groups of elements from a particular data structure. They can be of different types based on their approach or the data structure in which the element should be found.

5. **Sorting Algorithm:**

   Sorting is arranging a group of data in a particular manner according to the requirement. The algorithms which help in performing this function are called sorting algorithms. Generally sorting algorithms are used to sort groups of data in an increasing or decreasing manner.

6. **Hashing Algorithm:**

   Hashing algorithms work similarly to the searching algorithm. But they contain an index with a key ID. In hashing, a key is assigned to specific data.

7. **Divide and Conquer Algorithm:**

   This algorithm breaks a problem into sub-problems, solves a single sub-problem, and merges the solutions to get the final solution. It consists of the following three steps:

   Divide

   Solve

   Combine

8. **Greedy Algorithm:**

   In this type of algorithm, the solution is built part by part. The solution for the next part is built based on the immediate benefit of the next part. The one solution that gives the most benefit will be chosen as the solution for the next part.

9. **Dynamic Programming Algorithm:**

   This algorithm uses the concept of using the already found solution to avoid repetitive calculation of the same part of the problem. It divides the problem into smaller overlapping subproblems and solves them.

10. **Randomized Algorithm:**

    In the randomized algorithm, we use a random number so it gives immediate benefit. The random number helps in deciding the expected outcome.

To learn more about the types of algorithms refer to the article about "Types of Algorithms".

Advantages of Algorithms:

i. It is easy to understand.
ii. An algorithm is a step-wise representation of a solution to a given problem.
iii. In an Algorithm the problem is broken down into smaller pieces or steps hence, it is easier for the programmer to convert it into an actual program.

Disadvantages of Algorithms:

i. Writing an algorithm takes a long time so it is time-consuming.
ii. Understanding complex logic through algorithms can be very difficult.
iii. Branching and Looping statements are difficult to show in Algorithms(imp).

How to Design an Algorithm?

To write an algorithm, the following things are needed as a pre-requisite:

> The problem that is to be solved by this algorithm i.e. clear problem definition.
> The constraints of the problem must be considered while solving the problem.
> The input to be taken to solve the problem.
> The output is to be expected when the problem is solved.
> The solution to this problem is within the given constraints.

Then the algorithm is written with the help of the above parameters such that it solves the problem.

Example:
Consider the example to add three numbers and print the sum.

Step 1: Fulfilling the pre-requisites

As discussed above, to write an algorithm, its prerequisites must be fulfilled.

The problem that is to be solved by this algorithm: Add 3 numbers and print their sum.

The constraints of the problem that must be considered while solving the problem: The numbers must contain only digits and no other characters.

The input to be taken to solve the problem: The three numbers to be added.

The output to be expected when the problem is solved: The sum of the three numbers taken as the input i.e. a single integer value.

The solution to this problem, in the given constraints: The solution consists of adding the 3 numbers. It can be done with the help of the '+' operator, or bit-wise, or any other method.

Step 2: Designing the algorithm

Now let's design the algorithm with the help of the above pre-requisites:

Algorithm to add 3 numbers and print their sum:

START

Declare 3 integer variables num1, num2, and num3.

Take the three numbers, to be added, as inputs in variables num1, num2, and num3 respectively.

Declare an integer variable sum to store the resultant sum of the 3 numbers.

Add the 3 numbers and store the result in the variable sum.

Print the value of the variable sum

END

Step 3: Testing the algorithm by implementing it.

To test the algorithm, let's implement it in C language.

Program:

```
// C++ program to add three numbers
// with the help of above designed
// algorithm
#include <bits/stdc++.h>
using namespace std;
int main()
{
   // Variables to take the input of
   // the 3 numbers
   int num1, num2, num3;
   // Variable to store the resultant sum
   int sum;
   // Take the 3 numbers as input
   cout << "Enter the 1st number: ";
   cin >> num1;
   cout << " " << num1 << endl;

   cout << "Enter the 2nd number: ";
   cin >> num2;
   cout << " " << num2 << endl;
   cout << "Enter the 3rd number: ";
   cin >> num3;
   cout << " " << num3;
   // Calculate the sum using + operator
   // and store it in variable sum
   sum = num1 + num2 + num3;
   // Print the sum
   cout << "\nSum of the 3 numbers is: "
        << sum;
   return 0;
}

// This code is contributed by A.A Usaini
```

Output

```
Enter the 1st number:  4196384
Enter the 2nd number:  0
Enter the 3rd number:  4196992
Sum of the 3 numbers is: 8393376
```

Here is the step-by-step algorithm of the code:

i. Declare three variables num1, num2, and num3 to store the three numbers to be added.

ii. Declare a variable sum to store the sum of the three numbers.

iii. Use the cout statement to prompt the user to enter the first number.

iv. Use the cin statement to read the first number and store it in num1.

v. Use the cout statement to prompt the user to enter the second number.

vi. Use the cin statement to read the second number and store it in num2.

vii. Use the cout statement to prompt the user to enter the third number.

viii. Use the cin statement to read and store the third number in num3.

ix. Calculate the sum of the three numbers using the + operator and store it in the sum variable.

x. Use the cout statement to print the sum of the three numbers.

xi. The main function returns 0, which indicates the successful execution of the program.

2.3 Flowchart

Flowcharts

Flowcharts are the visual representations of an algorithm or a process. Flowcharts use symbols/shapes like arrows, rectangles, and diamonds to properly explain the sequence of steps involved in the algorithm or process. Flowcharts have their use cases in various fields such as software development, business process modeling, and engineering.

Why use Flowcharts

Flowcharts are used due to the numerous amount of benefits they provide. Below are some of the important reasons to use flowcharts:

They provide clarity and simplification to the complex processes and algorithms, which in turn helps other people to understand them easily.

Flowcharts provide a universal visual language that can be understood by anyone across different teams and helps reduce miscommunications.

They are an optimal solution for documenting standard operating procedures, workflows, or business processes. This makes it easier to train new employees.

Flowcharts help in increasing the visualization of the problem being solved which enables more informed and data-driven choices.

Types of Flowcharts

There are many types of flowcharts, each is designed to represent different kinds of processes and information. Some common types of flowcharts are:

i. **Process Flowchart:** It represents the sequence of steps in a process. They are frequently used in business process modeling, manufacturing, and project management

ii. **Swimlane Flowchart:** It organizes the process into different lanes, each representing a different person or department and is used for illustrating how different teams or departments collaborate within a process

iii. **Workflow Diagram:** It represents how tasks, documents, or information move through a system and is commonly used in office processes or software development

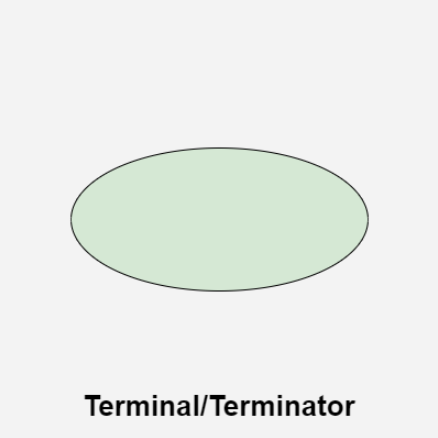
iv. **Data Flow Diagram (DFD):** It focuses on detailing the inputs, processes, and outputs. Used in system design and analysis to model the flow of data within a system

v. **Decision Flowchart:** It focuses on mapping out decision points within a process and the possible outcomes of each decision. It is used in decision-making scenarios

Symbols used in Flowchart Designs

1. Terminal/Terminator

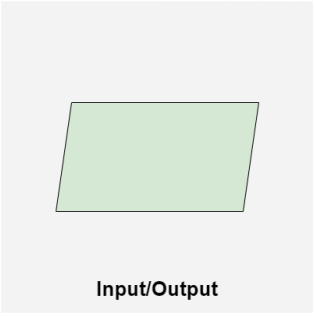
The oval symbol indicates Start, Stop and Halt in a program's logic flow. A pause/halt is generally used in a program logic under some error conditions. Terminal is the first and last symbols in the flowchart.



Source: *https://www.geeksforgeeks.org/introduction-to-algorithms*

2. Input/Output

A parallelogram denotes any function of input/output type. Program instructions that take input from input devices and display output on output devices are indicated with parallelogram in a flowchart.



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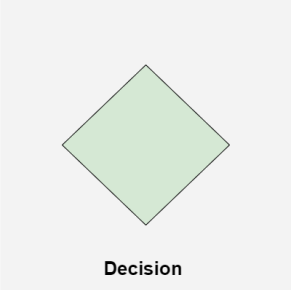
3. Action/Process

A box represents arithmetic instructions, specific action or operation that occurs as a part of the process. All arithmetic processes such as adding, subtracting, multiplication and division are indicated by action/process symbol.

Source: *https://www.geeksforgeeks.org/introduction-to-algorithms*

4. Decision

Diamond symbol represents a decision point. Decision based operations such as yes/no question or true/false are indicated by diamond in flowchart.



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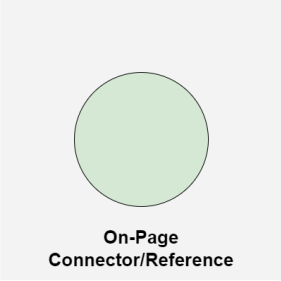
5. On-Page Connector/Reference

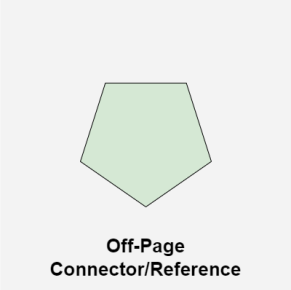
Whenever flowchart becomes complex or it spreads over more than one page, it is useful to use connectors to avoid any confusions. connectors are used to indicate a jump from one part of the flowchart to another without drawing long or complicated lines. On-Page Connector is represented by a small circle



Source: *https://www.geeksforgeeks.org/introduction-to-algorithms*

6. Off-Page Connector/Reference

Whenever flowchart becomes complex or it spreads over more than one page, it is useful to use connectors to avoid any confusions. connectors are used to indicate a jump from one part of the flowchart to another without drawing long or complicated lines. Off-Page Connector is represented by a pentagon.



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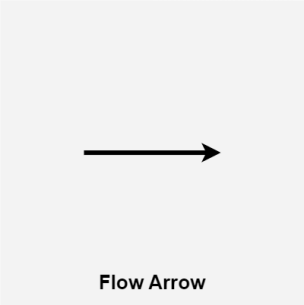
7. Flow lines

Flow lines indicate the exact sequence in which instructions are executed. Arrows represent the direction of flow of control and relationship among different symbols of flowchart.



Source: *https://www.geeksforgeeks.org/introduction-to-algorithms*

Rules For Creating a Flowchart

A flowchart is a graphical representation of an algorithm. It should follow some rules while creating a flowchart

Rule 1: Flowchart opening statement must be ‘start’ keyword.

Rule 2: Flowchart ending statement must be ‘end’ keyword.

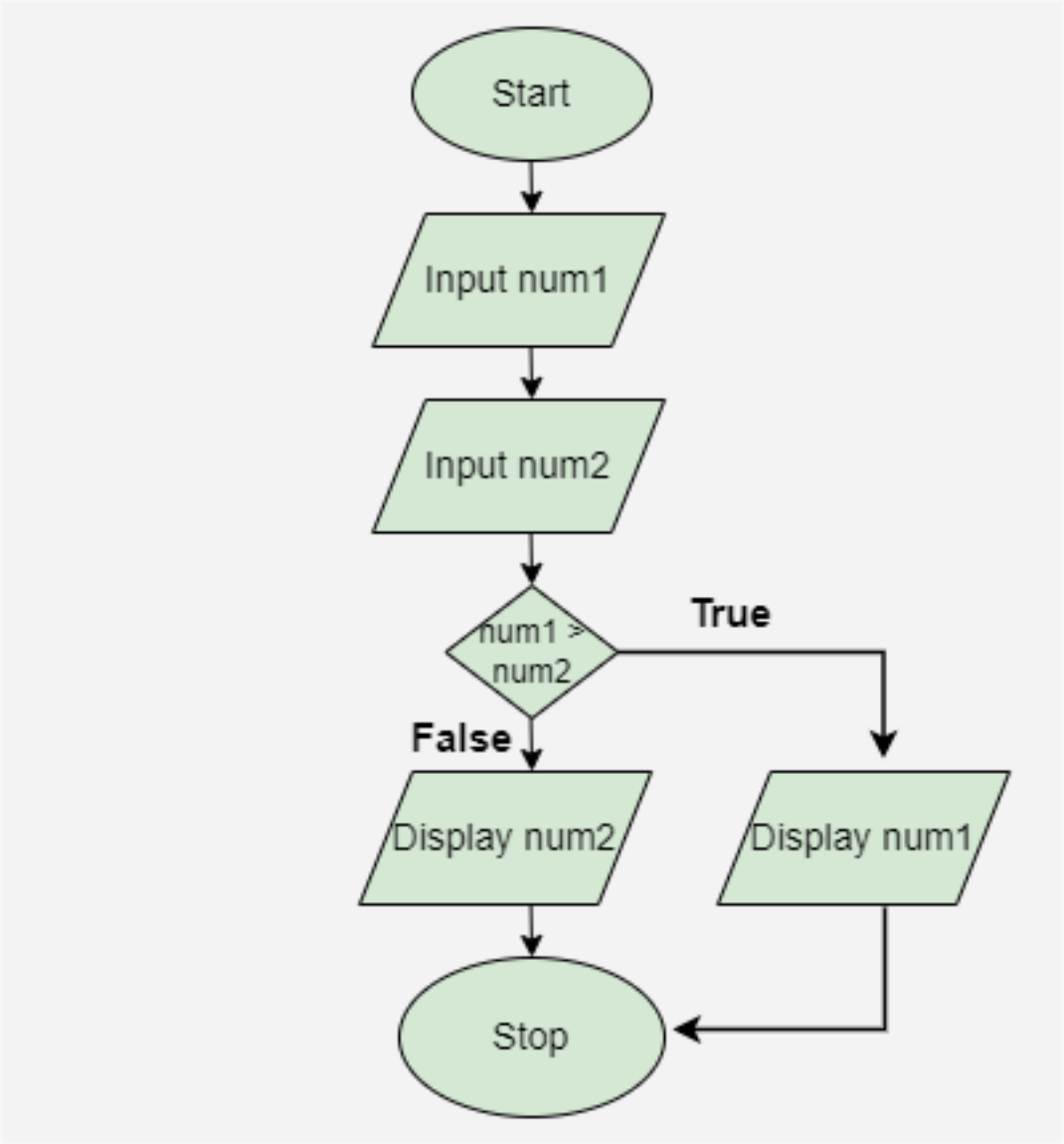
Rule 3: All symbols in the flowchart must be connected with an arrow line.

Rule 4: Each decision point should have two or more distinct outcomes.

Rule 5: Flow should generally move from top to bottom or left to right.

Example of a Flowchart

Draw a flowchart to input two numbers from the user and display the largest of two numbers.



Below is the explanation of the above flowchart:

- Start: The process begins with the Start symbol, indicating the start of the program.
- Input num1: The first number, represented as num1, is entered.
- Input num2: The second number, represented as num2, is entered.
- Decision (num1 > num2): A decision point checks if num1 is greater than num2.

- If True, the process moves to the next step where num1 will be displayed.
- If False, the process moves to display num2.

- Stop: The process ends with the Stop symbol, signaling the conclusion of the program.

Advantages of using a Flowchart

i. Flowcharts are a better way of communicating the logic of the system.
ii. Flowcharts act as a guide for blueprint during program designed.
iii. Flowcharts help in debugging process.
iv. With the help of flowcharts programs can be easily analyzed.
v. They provide better documentation.
vi. Flowcharts serve as a good proper documentation.

Disadvantages of using a Flowchart

i. It is difficult to draw flowcharts for large and complex programs.
ii. There is no standard to determine the amount of detail.
iii. It is very difficult to modify the Flowchart.
iv. Making a flowchart is costly.
v. If changes are done in software, then the flowchart must be redrawn

2.4 Pseudocode

A Pseudocode is defined as a step-by-step description of an algorithm. Pseudocode does not use any programming language in its representation instead it uses the simple English language text as it is intended for human understanding rather than machine reading.

Pseudocode is the intermediate state between an idea and its implementation(code) in a high-level language.

What is the need for Pseudocode

Pseudocode is an important part of designing an algorithm, it helps the programmer in planning the solution to the problem as well as the reader in understanding the approach to the problem. Pseudocode is an intermediate state between algorithm and program that plays supports the transition of the algorithm into the program.

Pseudocode is an intermediate state between algorithm and program

How to write Pseudocode?

Before writing the pseudocode of any algorithm the following points must be kept in mind.

- Organize the sequence of tasks and write the pseudocode accordingly.
- At first, establishes the main goal or the aim. Example:

This program will print first N numbers of Fibonacci series.

- Use standard programming structures such as if-else, for, while, and cases the way we use them in programming. Indent the statements if-else, for, while loops as they are indented in a program, it helps to comprehend the decision control and execution mechanism. It also improves readability to a great extent. Example:

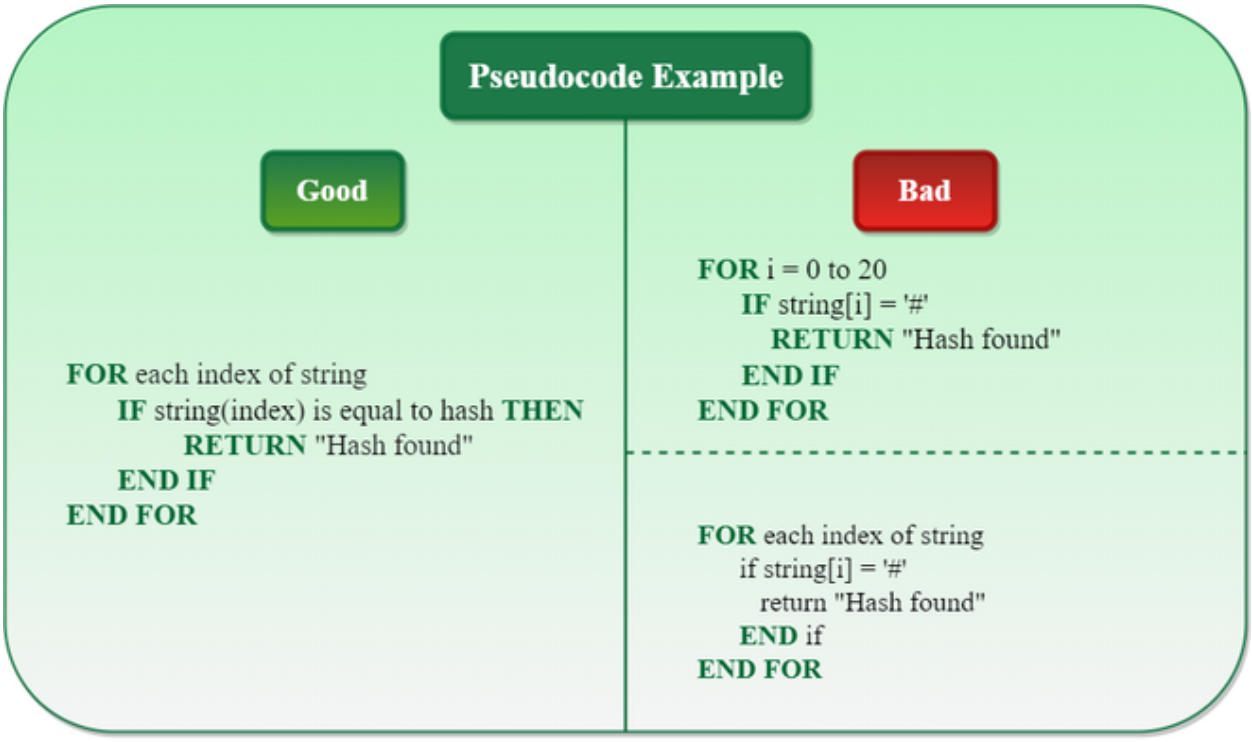
```
IF “1”
  print response
    “I AM CASE 1”

IF “2”
  print response
    “I AM CASE 2”
```

- Use appropriate naming conventions. The human tendency follows the approach of following what we see. If a programmer goes through a pseudo code, his approach will be the same as per that, so the naming must be simple and distinct.
- Reserved commands or keywords must be represented in capital letters. Example: if you are writing IF…ELSE statements then make sure IF and ELSE be in capital letters.
- Check whether all the sections of a pseudo code are complete, finite, and clear to understand and comprehend. Also, explain everything that is going to happen in the actual code.

- Don’t write the pseudocode in a programming language. It is necessary that the pseudocode is simple and easy to understand even for a layman or client, minimizing the use of technical terms.

Good vs Bad ways of writing Pseudocode:



Pseudocode Examples:

1. Binary search Pseudocode:

Binary search is a searching algorithm that works only for sorted search space. It repeatedly divides the search space into half by using the fact that the search space is sorted and checking if the desired search result will be found in the left or right half.

Example: Given a sorted array Arr[] and a value X, The task is to find the index at which X is present in Arr[].

Below is the pseudocode for Binary search.

```
BinarySearch(ARR, X, LOW, HIGH)
    repeat till LOW = HIGH
      MID = (LOW + HIGH)/2
      if (X == ARR[mid])
          return MID

      else if (x > ARR[MID])
          LOW = MID + 1
```

2. Quick sort Pseudocode:

***QuickSort** is a **Divide and Conquer algorithm**.* It picks an element as a pivot and partitions the given array around the picked pivot.
Say last element of array is picked as pivot then all elements smaller than pivot element are shifted on the left side of pivot and elements greater than pivot are shifted towards the right of pivot by swapping, the same algorithm is repeatedly followed for the left and right side of pivot until the whole array is sorted.

Below is the pseudocode for Quick sort

```
QUICKSORT(Arr[], LOW, HIGH) {
  if (LOW < HIGH) {
     PIVOT = PARTITION(Arr, LOW, HIGH);
     QUICKSORT(ARR, LOW, PIVOT – 1);
     QUICKSORT(ARR, PIVOT + 1, HIGH);
  }
}
```

2.5 Summary

Algorithm: A step-by-step technique or formula for addressing a problem. It defines a series of procedures to complete a certain objective.

Flowchart: A visual depiction of an algorithm, utilizing symbols to symbolize distinct sorts of operations or processes. It assists in understanding the flow of processes.

Pseudocode: A high-level explanation of an algorithm, utilizing a structured yet plain-language manner. It bridges the gap between normal language and programming syntax.

2.6 Assessment Questions

1. Algorithm, Flowchart, and Pseudocode
2. Define an algorithm and offer an example.
3. Describe how a flowchart might assist knowledge of an algorithm.
4. Write a pseudocode for a basic job (e.g., finding the maximum of three integers).

Module 2: Introduction to Basic Programming

Unit 3: Basic Programming Language

Flow of the Unit

3.0 Objective
3.1 Introduction
3.2 Program Structure
3.3 Basic Language & Data Types
3.4 Program Loops
3.5 Summary
3.6 Assessment Question
3.7 Reference

3.0 Objective

a. Describe programming language.
b. Write simple program.
c. Identify different data types, keyword and program loops.
d. Identify structure of basic programming

3.1 Introduction

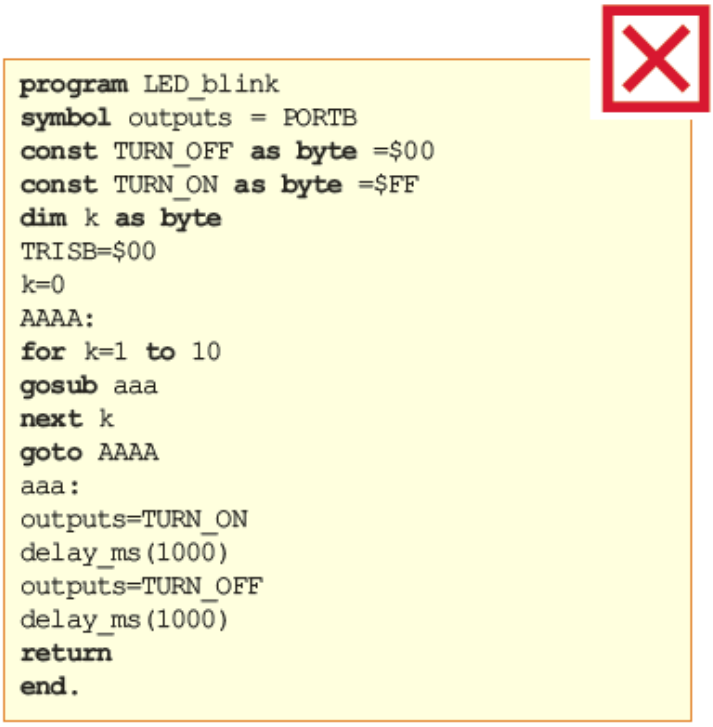
Similar to the use of any language which is not limited to books and magazines only, the Basic programming language is not closely related to any special type of computer, processor or operating system. It is a general-purpose language. This fact can make some problems as the Basic language slightly varies depending on its application (like different dialects of one language). So, we are not going to provide you with a detailed description of all the attributes of Basic in this book. Instead, we are going to describe a concrete application of the Basic programming language, i.e. Basic used by the mikroBasic PRO for PIC compiler.

The Basic programming language is a simple and easy to understand programming language. To use it correctly, it is sufficient to know just a few basic elements that every program consists of. These are:

- Identifiers
- Comments
- Operators
- Expressions
- Instructions
- Constants
- Variables

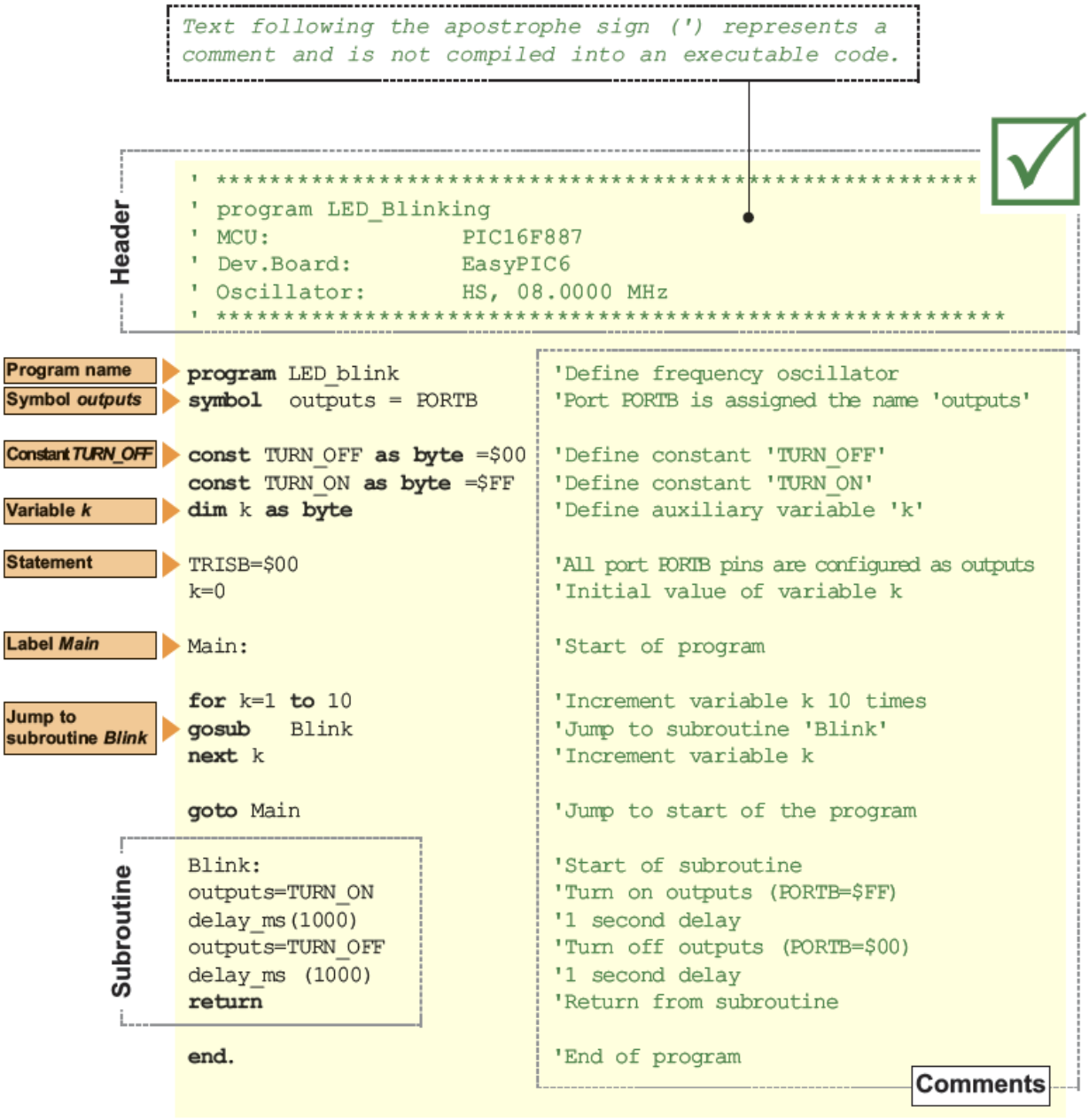
- Symbols
- Directives
- Labels
- Procedures and functions
- Modules

Here is an example of how you should not write a program. No comments are included, labels' names are meaningless, code sections are not grouped… This program is going to work properly, but its purpose and way of execution will be only known to the programmer who has written it (at least for a day or two).



```
program LED_blink
symbol outputs = PORTB
const TURN_OFF as byte =$00
const TURN_ON as byte =$FF
dim k as byte
TRISB=$00
k=0
AAAA:
for k=1 to 10
gosub aaa
next k
goto AAAA
aaa:
outputs=TURN_ON
delay_ms(1000)
outputs=TURN_OFF
delay_ms(1000)
return
end.
```

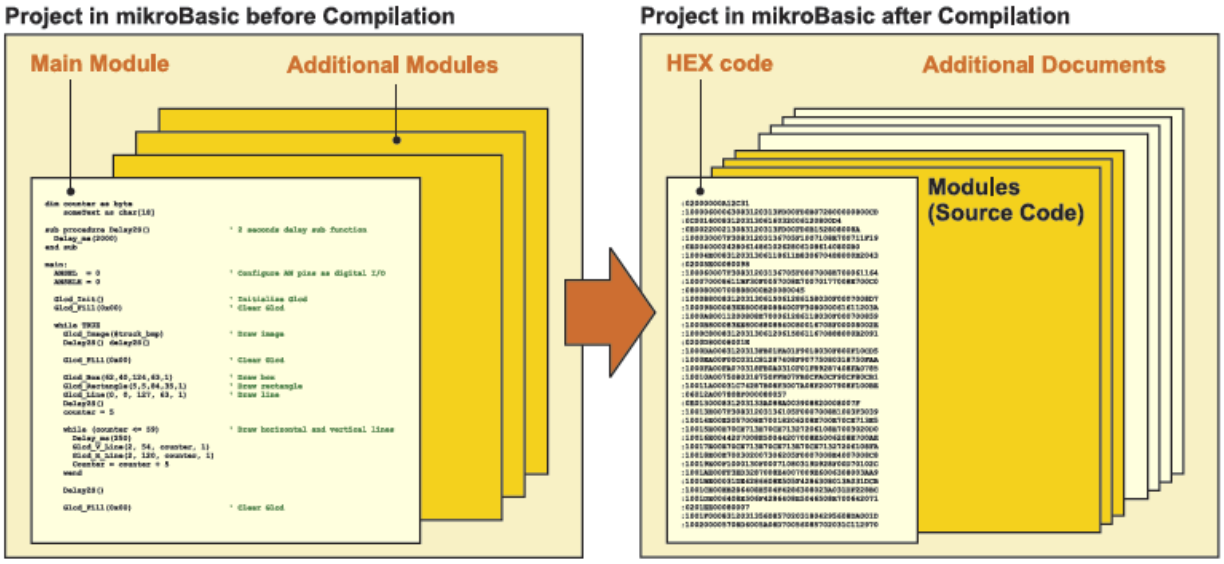
Figure below illustrates the structure of a simple program written in Basic, pointing out the parts it consists of. This is an example of how you should write a program. Differences are more than obvious...



3.2 Program Structure

Similar to other programming languages, Basic provides a set of strictly defined rules to be observed when writing programs. For a program to be written in Basic, it is necessary to install a software which provides the appropriate work environment and understands these rules on your PC... When you write a letter, you need a word processing program, don't you? In this case, you need the mikroBasic PRO for PICcompiler. Unlike most programs you have already got used to dealing with, the process of writing programs in the compiler doesn't start by selecting the

File>New option, but Project>New. Why is that? Well, you write a program in a document with the .mbas extension (mikroBasic). You diligently write, write, write... When you compile it into a HEX code, a new document with the .hex extension will be created. At the same time the compiler will automatically create several documents in addition to it. The purpose of these documents is not important at this point. Of course, there must be something to connect them all. You get it - we are talking about a project. The program you write is just a part of it.



Just to be sure that we are on the same page... From now on the word module refers to a document with the .mbas extension. The text it contains is referred to as a program. Every project written in the mikroBasic PRO for PIC compiler has the .mbppi extension (microBasicProject for PIC) and consists of at least one module (Main Module). Every project in mikroBasic PRO for PIC requires a single main module. It is identified by the keyword program and instructs the compiler from where to start the process of compiling. When you successfully create an empty project in Project Wizard, the main module will be automatically displayed in the Code Editor window:

```
program MyProject ' The main module is called MyProject here
main: ' Main procedure
... '*
... '* Write program code here
... '*
end.
```

IDENTIFIERS

Identifiers are arbitrary names assigned to the basic language objects such as constants, variables,

functions, procedures etc. Somebody just came to an idea to use the word identifier instead of name. As simple as that. Here are a few rules to be observed when using identifiers: Identifiers may contain all the letters of alphabet (both upper and lower case), digits (0-9) and the underscore character (_).

The first character of an identifier must not be a digit.

No identifier may contain special characters such as ! [{ # $ % & etc. Basic is not case-sensitive, which means that FIRST, first and First will be considered identical.

The ^ (caret) symbol is used to denote an exponentiation operator, the * (asterisk) symbol is used to denote multiplication, while other symbols have their usual meanings.

Keywords being already used by the compiler must not be used as identifiers The mikroBasic keywords are listed in the following table:

Abstract	Forward	Rx
And	Function	Resourcestring
Array	Goto	Requires
As	Idata	Repeat
At	If	Reintroduce
Asm	Ilevel	Register
Assembler	Implementation	Record
Automated	In	Readonly
Bdata	Index	Read
Begin	Inherited	Raise
Bit	Initialization	Published
Case	Inline	Public
Cdecl	Interface	Protected
Class	Io	Property
Code	Is	Program
Compact	Label	Procedure
Const	Large	Private
Constructor	Library	Platform
Contains	Message	Pdata
	Mod	Small

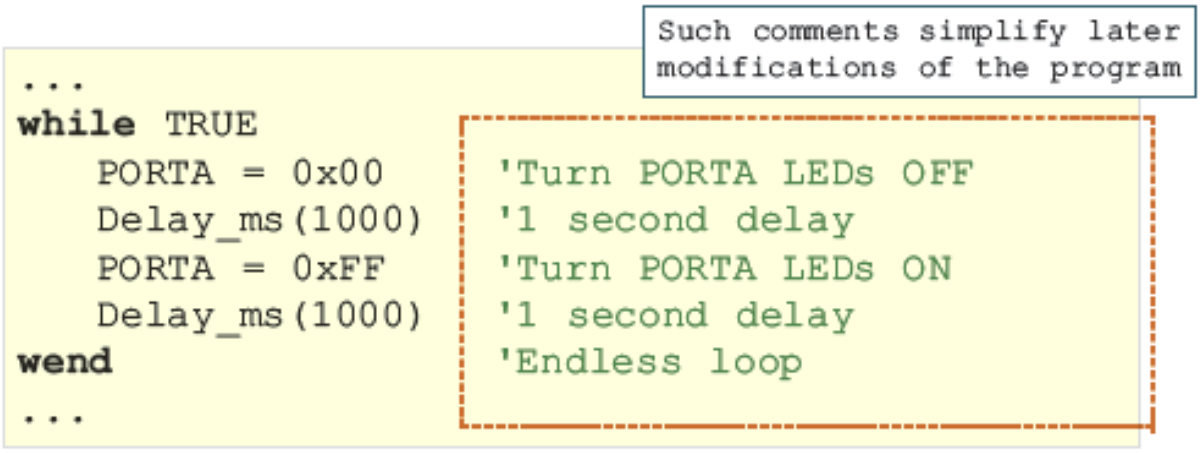
Data	Name	Stdcall
Default	Near	Stored
Deprecated	Nil	String
Destructor	Not	Stringresource
Dispid	Object	Then
Dispinterface	Of	Threadvar
Div	On	To
Do	Or	Try
Downto	Org	Type
Dynamic	Out	Unit
Else	Overload	Until
End	Override	Uses
Except	Package	Var
Export	Packed	Virtual
Exports	Pascal	Volatile
External	Shr	While
Far	Shl	With
File	Sfr	Write
Finalization	Set	Writeonly
Finally	Sbit	Xdata
For	Safecall	Xor.

A list of identifiers which must not be used in the program

COMMENTS

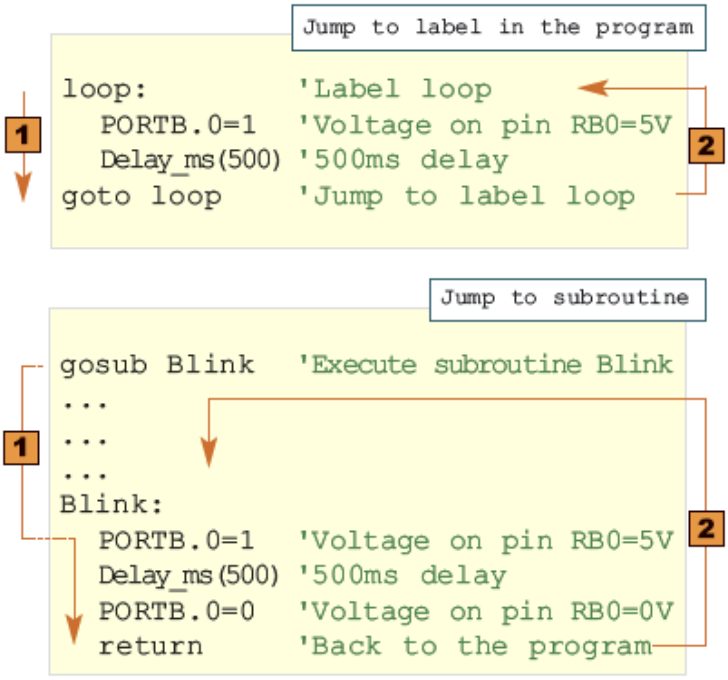
Comments are parts of the program used to provide more information about the program and make it clear to the user. In Basic, any text following a single quotation mark (') is considered a comment. Comments are not compiled into executable code. The compiler is capable of recognizing special characters used to mark where comments start and completely ignores the following text during compilation. Even though comments cannot affect the program execution, they are as important as any other part of the program because almost every program needs to be improved, modified,

upgraded or simplified at some point. Without comments, it is almost impossible to understand even the simplest programs.



LABELS

Labels provide the easiest way of controlling the program flow. They are used to mark particular lines in the program where jump instruction and appropriate subroutine are to be executed. All labels must be terminated by ':' so that the compiler can easily recognize them.



CONSTANTS

A constant is a number or a character the value of which cannot be changed during the program execution. Unlike variables, constants are stored in ROM memory of the microcontroller in order to

save as much memory space of RAM as possible. The compiler recognizes constants by their names and prefix const. Every constant is declared under unique name which must be a valid identifier. Constants are available in decimal, hexadecimal and binary formats. The compiler distinguishes between them according to their prefixes. If a constant has no prefix, it is considered decimal by default.

FORMAT	PREFIX	EXAMPLE
Decimal		const MAX = 100
Hexadecimal	0x or $	const MAX = 0xFF
Binary	Floating point	const MAX = %11011101

Constants are declared in the declaration part of the program or routine. The syntax of constants is:

```
const constant_name [as type] = value
```

Constant names are usually written in capitals. The type of a constant is automatically recognized by its size. In the following example, the constant *MINIMUM* is considered a signed integer and will be stored within two bytes of *Flash* memory (16 bits):

```
const MINIMUM = -1000 ' Declare constant MINIMUM
```

Type of constant is optionally specified. In the absence of type, the compiler assumes the 'smallest' type that can accommodate the constant value.

```
const MAX as longint = 10000
const MIN = 1000 ' Compiler will assume word type
const SWITCH = "n" ' Compiler will assume char type
```

In the following example, a constant named *T_MAX* is declared so as to have a fractional value 32.60. Now, the program can compare the measured temperature to that constant with a meaningful name instead to number 32.60.

```
const T_MAX = 32.60 ' Declare temperature T_MAX
const T_MAX = 3.260E1 ' Another way of declaring constant T_MAX
```

A string constant consists of a sequence of characters. They are enclosed within double quotation marks. A blank space may also be included in the string constant as a character. String constants are used to represent non-numeric quantities such as names, addresses, messages etc.

```
const Message_1 = "Press the START button" ' Message 1 for LCD
const Message_2 = "Press the RIGHT button" ' Message 2 for LCD
const Message_3 = "Press the LEFT button" ' Message 3 for LCD
```

In this example, sending the *Message_1* constant to an LCD will cause the message *'press the START button'* to be displayed.

VARIABLES

A variable is a named object able to contain a data which can be modified during program execution. Every variable is declared under a unique name which must be a valid identifier. For example, to add two numbers (number1 + number2) in the program, it is necessary to have a variable to represent what we in everyday life call the sum. In this case number1, number and sum are variables. The syntax of one single variable declaration is as follows:

```
dim variable_name as type
```

Variables in Basic are typed, which means that it is necessary to specify the type of data a variable is to receive. Variables are stored in RAM and the memory space occupied (in bytes) depends on their type. In addition to single declarations, variables of the same type can be declared as a list. Here, identifier_list is a comma-delimited list of valid identifiers, whereas type can be any data type.

```
dim i, j, k as byte 'Define variables i, j, k
dim counter, temp as word 'Define variables counter and temp
```

SYMBOLS

Symbols in Basic allow you to create simple macros without parameters. It means that any code line may be replaced with one single identifier. Symbols, when used properly, can increase code legibility and reusability. Symbols are declared at the beginning of the module, right after the module name and optional include directive. The scope of a symbol is always limited to the module in which it has been declared.

```
symbol symbol_name = code
```

Here, symbol_name must be a valid identifier to be used throughout the code. The code specifier can be any code line (literals, assignments, function calls, etc).

```
symbol MAXALLOWED = 216 ' Symbol MAXALLOWED for numeric value
symbol OUT = PORTA ' Symbol OUT for SFR
symbol MYDELAY = Delay_ms(762) ' Symbol MYDELAY for procedure call
dim cnt as byte ' Variable cnt
main:
if cnt > MAXALLOWED then ' Program checks whether cnt > 216
 cnt = 0 ' If yes,
 OUT.1 = 0 ' the following three commands
 MYDELAY ' are to be executed
end if
... ' If not, program continues here
```

No RAM memory space is used for storing symbols being used in the program. The compiler will simply replace all symbols with appropriate code lines assigned to them when declared.

3.3 Basic Language Data Types

There are several data types that can be used in the Basic programming language. Table below shows the range of values these data may have when used in their basic form.

DATA TYPE	DESCRIPTION	SIZE (NUMBER OF BITS)	RANGE OF VALUES
bit	One bit	1	0 or 1
sbit	One bit	1	0 or 1
byte, char	Character	8	0 ... 255
short	Signed short integer	8	-127 ... 128
word	Unsigned integer	16	0 ... 65535
integer	Signed integer	16	-32768 ... 32767
longword	32-bit word	32	0 ... 4294967295
longint	32-bit signed word	32	-2147483648 ... 2147483647

float	Floating point	32	$\pm 1.17549435082*10^{-38}$ ... $\pm 6.80564774407*10^{38}$

OPERATORS

An operator is a symbol used to denote particular arithmetic, logic or some other operation. Every operation is performed upon one or more operands (variables or constants) in an expression. Besides, every operator features priority execution and associativity. If an expression contains more than one operand, the order of their execution is determined by the level of their priority. There are four priority categories in Basic. Operators belonging to the same category have equal priority. If two or more operators have the same priority level, the operations are performed from left to right. Parenthesis can be used to define the priority of the operation within an expression. Each category is assigned either left-to-right or rightto- left associativity rule. Refer to the table below.

PRIORITY	OPERATORS	ASSOCIATIVITY
High	@ not + -	from right to left
	* / div mod and << >>	from left to right
	+ - or xor	from left to right
Low	= <> < > <= >=	from left to right

ARITHMETIC OPERATORS

Arithmetic operators are used to perform arithmetic operations. These operations are performed upon numeric operands and always return numerical results. Binary operations are performed upon two operands, whereas unary operations are performed upon one operand. All arithmetic operators associate from left to right.

OPERATOR	OPERATION
+	Addition
-	Subtraction

*	Multiplication
/	Division - floating point
div	Division - round down
mod	Reminder

DIVISION BY ZERO

If a zero (0) is used explicitly as the second operand in the division operation (x div 0), the compiler will report an error and will not generate a code. In case of implicit division where the second operand is an object the value of which is 0 (x div y, where y=0), the result will be undefined.

RELATIONAL OPERATORS

Relational operators are used to compare two variables and determine the validity of their relationship. In mikroBasic, all relational operators return 255 if the expression is true, or zero (0) if it is false. The same applies in expressions such as 'if the expression is true then...'

OPERATOR	MEANING	EXAMPLE	TRUTH CONDITION
>	is greater than	b > a	if **b** is greater than **a**
>=	is greater than or equal to	a >= 5	If **a** is greater than or equal to **5**
<	is less than	a < b	if **a** Is less than **b**
<=	is less than or equal to	a <= b	if **a** Is less than or equal to **b**
=	is equal to	a = 6	if **a** Is equal to **6**
<>	is not equal to	a <> b	if **a** Is not equal to **b**

CONDITIONAL STATEMENTS

Conditions are common ingredients of a program. They enable one or a number of statements to be executed depending on the validity of an expression. In other words 'If the condition is met (...),

do (...). Otherwise, do (...)'. A conditional statement can be followed either by a single statement or by a block of statements to execute.

CONDITIONAL STATEMENT IF

The syntax of a simple form of the if statement is:

```
if expression then
operations
end if
```

If the result of expression is true (not 0), operations are performed, then the program proceeds with execution. If the result of expression is false (0), operations are not performed and the program immediately proceeds with execution. The if operator can also be used in combination with else operators:

If the result of expression is true (not 0), operations1 are performed, otherwise operations2 are performed. The program proceeds with execution after these operations are performed.

```
if expression then
operations1
else
other operations2
end if
```

NESTED IF STATEMENTS

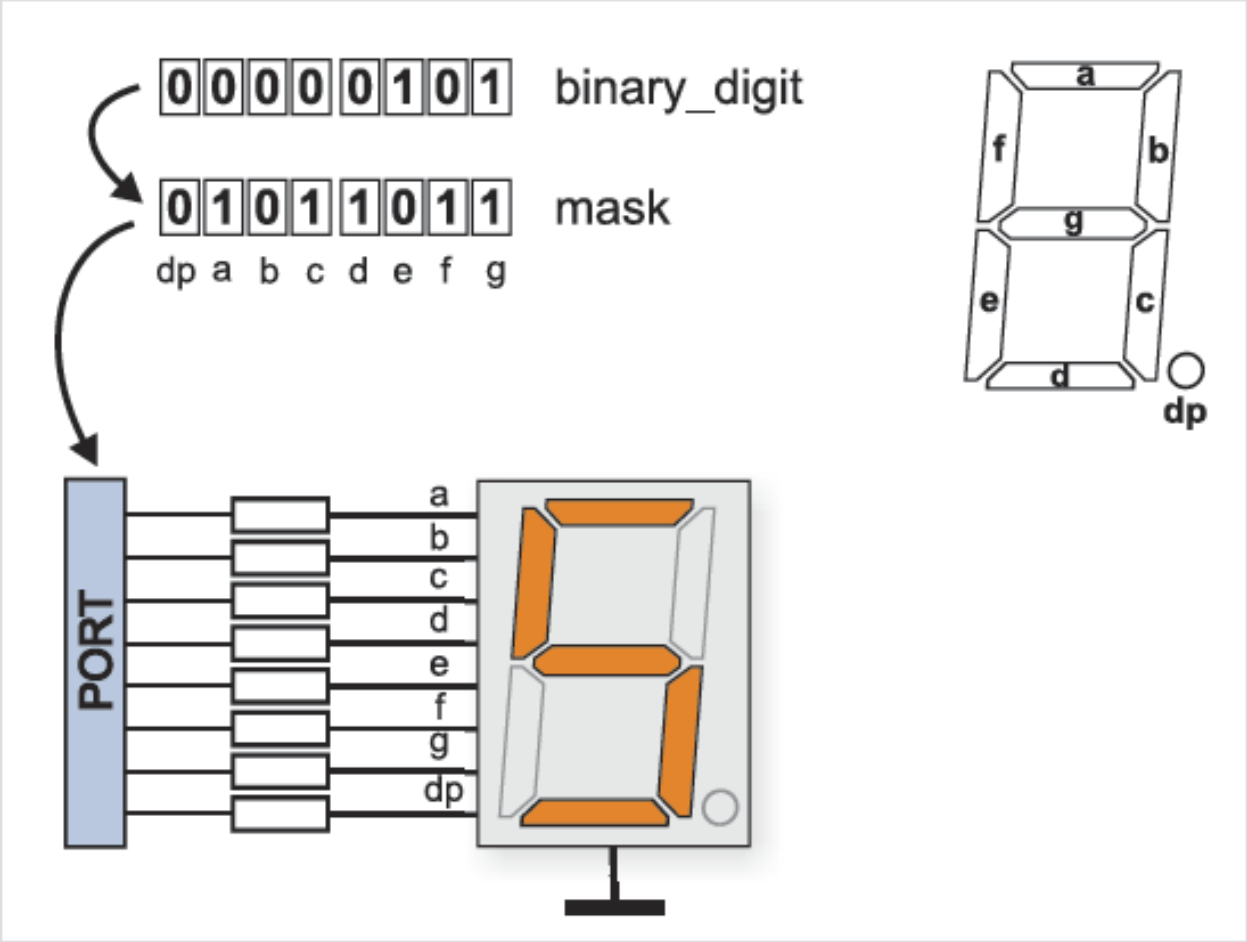
Nested if statement need additional attention. A nested if-statement is a statement used inside the other if-statement. As a rule, they are parsed starting from the most nested ifstatement, whereas each else statement is bound to the nearest available if on its left:

SELECT CASE STATEMENT

The select case statement is a conditional statement with multiple branching. It consists of a selector expression (condition) and a list of possible values of that expression. The syntax of the select case statement is: The selector specifier is an expression which should evaluate as integral value. Specifiers value_1...value_n represent selector's possible values and can be literals,

constants or constant expressions. Specifiers statements_1 ...statements_n can be any statements. The case else clause is optional. First, the selector expression is evaluated. It is then compared to all available values. If the match is found, the statements following the match evaluate and the select case statement terminates. If there are multiple matches, statements following the first match will be executed. If none of the values matches the selector, then default_statements in the case else clause (if there is one) are executed. Here is an example of the select case statement:

```
select case decimal_digit ' Decimal-digit value is being checked
case 0
mask = %01111110 ' Display "0"
case 1
mask = %00110000 ' Display "1"
case 2
mask = %01101101
case 3
mask = %01111001
case 4
mask = %00110011
case 5
mask = %01011011
case 6
mask = %01011111
case 7
mask = %01110000
case 8
mask = %01111111
case 9
mask = %01111011
end select
```



This program routine converts decimal digits into appropriate binary combination on the port in order to display them on an LED display.

3.4 Program Loops

Some instructions (operations) have to be executed more than once in the program. A set of commands being repeated makes a program loop. How many times it will be executed, i.e. how long the program will stay within a loop, depends on the conditions to leave the loop.

WHILE LOOP

The while loop is implemented when the number of iterations is not specified. It is necessary to check the iteration condition before a loop execution. Simply put, the while loop is executed while all necessary conditions for its execution are met... The syntax of the while loop looks as follows:

```
while expression
statements
```

```
wend
```

The statements specifier represents a group of statements which are executed repeatedly as long as the value of the expression specifier which represents an expression is true. In other words, the program remains in the loop until expression becomes false. The value of expression is checked before the next iteration is executed. Accordingly, if it is false before entering the loop, no iterations executes, i.e. statements will never be executed. The program will proceed with execution from the end of the while loop (from instructions following the wend instruction). A special type of the program loop is an endless loop. It is created if the condition to exit loop remains unchanged within the loop. In this case, the execution is simple as the result in brackets is always true (1 will allways be different from 0), which means that the program remains in the loop.

```
while 1 ' ‘true’ can be written instead of ‘1’
... ' Expressions will be unceasingly executed (endless loop)
...
wend
```

FOR LOOP

The for loop is implemented when the number of iterations is specified. The syntax of the for loop looks as follows:

```
for counter = initial_value to final_value [step step_value]
statements
next counter
```

Here, with each iteration of the loop, the counter variable is incremented by step_value. The step_value parameter is an optional integer value, considered 1 if omitted. Before the first iteration, the counter (counter) is set to its initial value (initial_value) and will be incremented until it reaches or exceeds the final value (final_value). Statements will be executed with each iteration. Iinitial_value and final_value should be expressions compatible with the counter, whereas the statements specifier can be any statement that doesn’t change the counter value. Note that the step_value parameter may be negative, thus enabling a countdown.

```
for k=1 to 5 ' Increase variable k five times (from 1 to 5) and
operation ' keep on executing "operation" every time
```

```
...
next k
```

A set of instructions (operation) will be executed five times. After that, it will be determined that the k<5 is false (after 5 iterations k=5) and the program will exit the for loop.

```
for k=1 to 5 ' Increase variable k five times (from 1 to 5) and
operation ' keep on executing "operation" every time
...
next k
```

DO LOOP

The do loop is implemented when the number of iterations is not specified. The loop is executed repeatedly until the expression evaluates to true. The syntax of the do loop

```
do
statements
loop until expression
```

In this case, the statements specifier represents a group of statements which are executed as long as the expression (expression) is true. The loop conditions are checked at the end of the loop, so the loop is executed at least once regardless of whether the condition is true or false. In the following example, the program remains in the do loop until variable a reaches 1E06 (a million iterations).

```
a = 0 ' Set initial value
do
a = a+1 ' Operation in progress
loop until a <= 1E06 ' Check condition
```

2.5 Summary

BASIC (Beginner's All-purpose Symbolic Instruction Code): A high-level programming language intended for simplicity of use. Without using complex syntax, it aids beginners in understanding the foundations of programming.

Features: Interactive and uncomplicated instructions, making it appropriate for teaching purposes and simple applications.

2.6 Assessment Questions

1. What are the primary properties of the BASIC programming language?
2. Write a simple BASIC program to compute the area of a rectangle.
3. Discuss two practical uses of BASIC in real-world circumstances.
4. How has BASIC affected current programming languages?

Module 2: Introduction to Basic Programming

Unit 4: Basic Application

Flow of the Unit

4.0 Objective
4.1 Introduction
4.2 Desktop Apps
4.3 Mobile Apps
4.4 Installing New Apps
4.5 Summary
4.6 Assessment Question
4.7 Reference

4.0 Objective

a. Describe different type of applications.
b. Able to install new apps desktops and mobile devices.
c. Identify muttiple types of applications both desktops and mobiles

4.1 Introduction

Individuals may have discussed using a program, an application, or an app. What does it specifically signify? An application is a kind of software designed to execute certain functions. Applications designed for desktop or laptop computers are referred to as desktop applications, whilst those intended for mobile devices are termed mobile apps.

Upon launching an application, it operates inside the confines of the operating system until it is terminated. Typically, many applications would be concurrently open, a practice referred to as multitasking.

An app is a prevalent phrase for an application, particularly for uncomplicated programs that may be downloaded at a low cost or free of charge. Numerous applications are also accessible for mobile devices and some televisions.

4.2 Desktop Apps

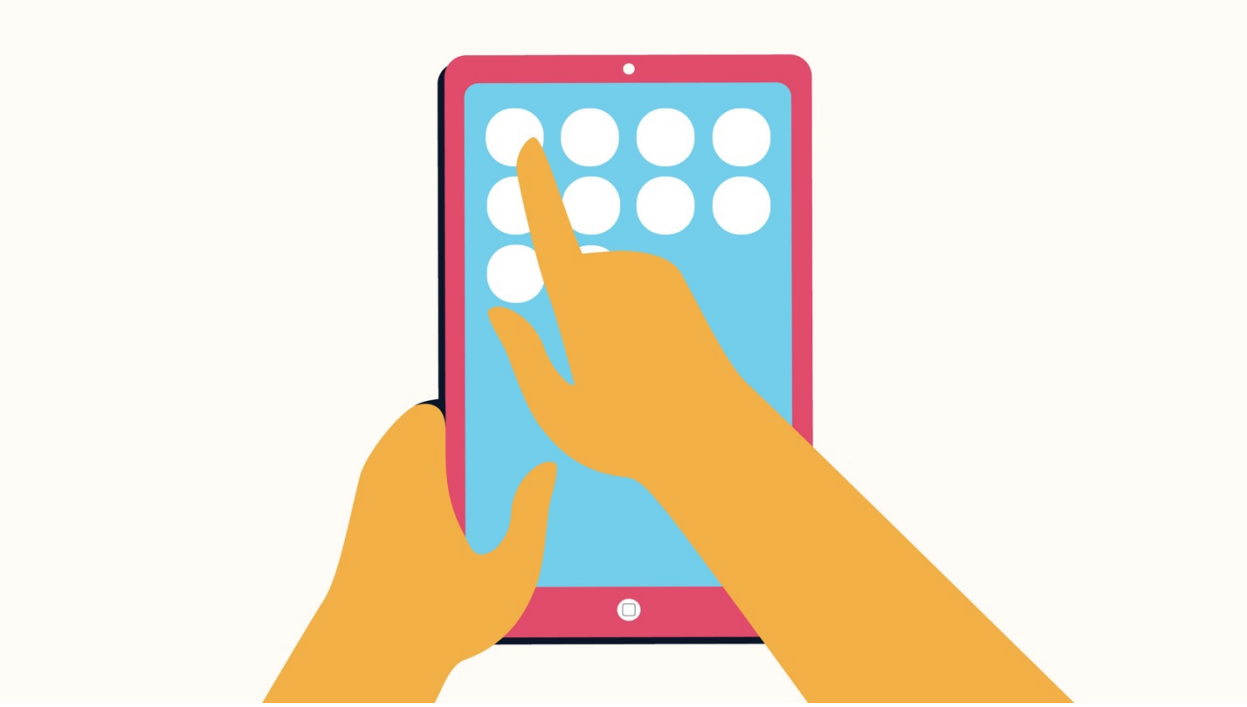
There are innumerable desktop programs, and they fall into various categories. Some are more full featured (like Microsoft Word), while others may simply accomplish one or two things (like a clock or calendar software). Below are just a few sorts of programs you could utilize. **Word processors:** A word processor lets you to compose a letter, design a poster, and produce many other sorts of documents. The most well-known word processor is Microsoft Word.

Web browsers: A web browser is the tool you use to access the Internet. Most computers come with a web browser pre-installed, but you may also download a different one if you like. Examples of browsers include Internet Explorer, Mozilla Firefox, Google Chrome, and Safari.

Media players: If you want to listen to MP3s or view movies you've downloaded, you'll need to utilize a media player. Windows Media Player and iTunes are popular media players.

4.3 Mobile Applications

Desktop and laptop computers aren't the only devices that can execute programs. You may also download applications for mobile devices like smartphones and tablets. Here are a few examples of mobile applications.



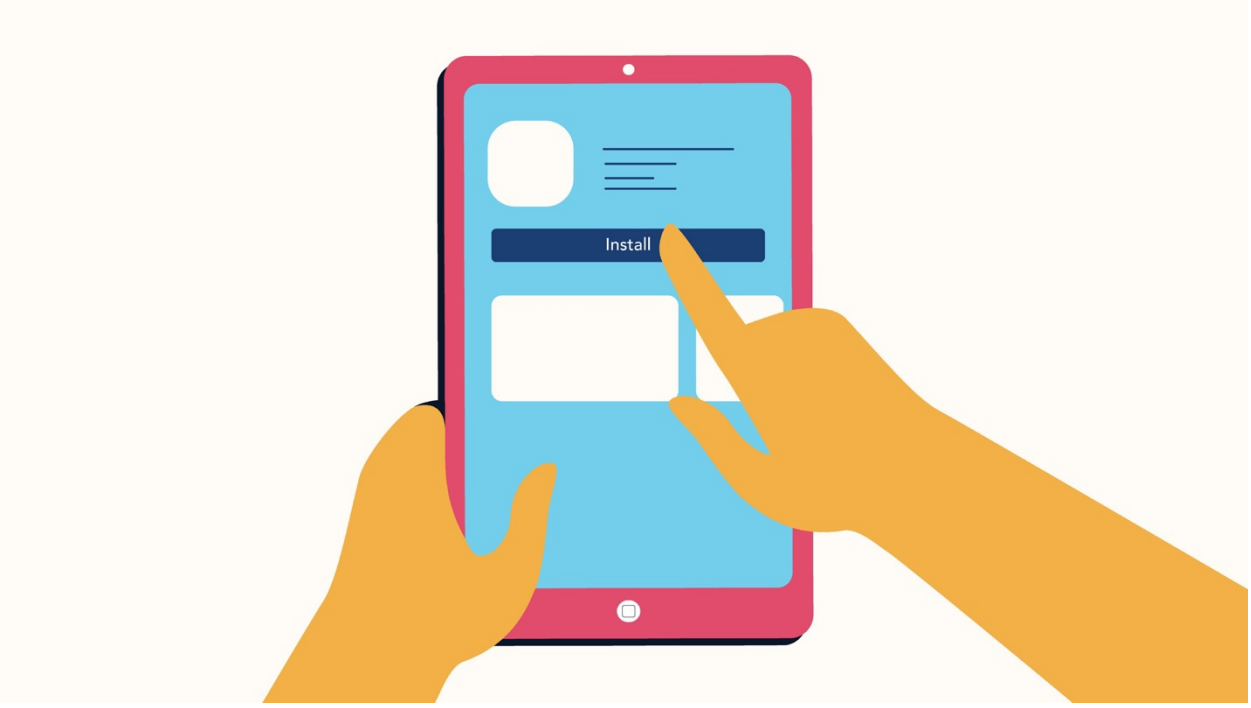
Gmail: You may use the Gmail app to conveniently browse and send emails from your mobile device. It's accessible on Android and iOS devices.

Instagram: You may use Instagram to instantly share images with your friends and family. It's available on Android and iOS.

Duolingo: With a mix of quizzes, games, and other activities, this software may help you learn new languages. It's available on Android and iOS.

4.4 Installing New Apps

Every computer and mobile device will come with certain apps already built in, such as a web browser and media player. However, you may also buy and install other applications to offer extra functionality. You may study our courses on Installing Software on Your Windows PC, Installing Software on Your Mac, and Free Software to learn more.



Installing applications on your Windows PC

Your computer enables you to perform some truly remarkable things. Digital picture editing, sophisticated computer games, video streaming—all of these things are feasible due of various kinds of software. Developers are continually producing new software apps, which enable you to accomplish even more with your computer.

Installing from a CD-ROM

From the mid-1990s to the late 2000s, the most frequent method to receive new software was to buy a CD-ROM. You could then insert the disc, and the computer would walk you through the installation.

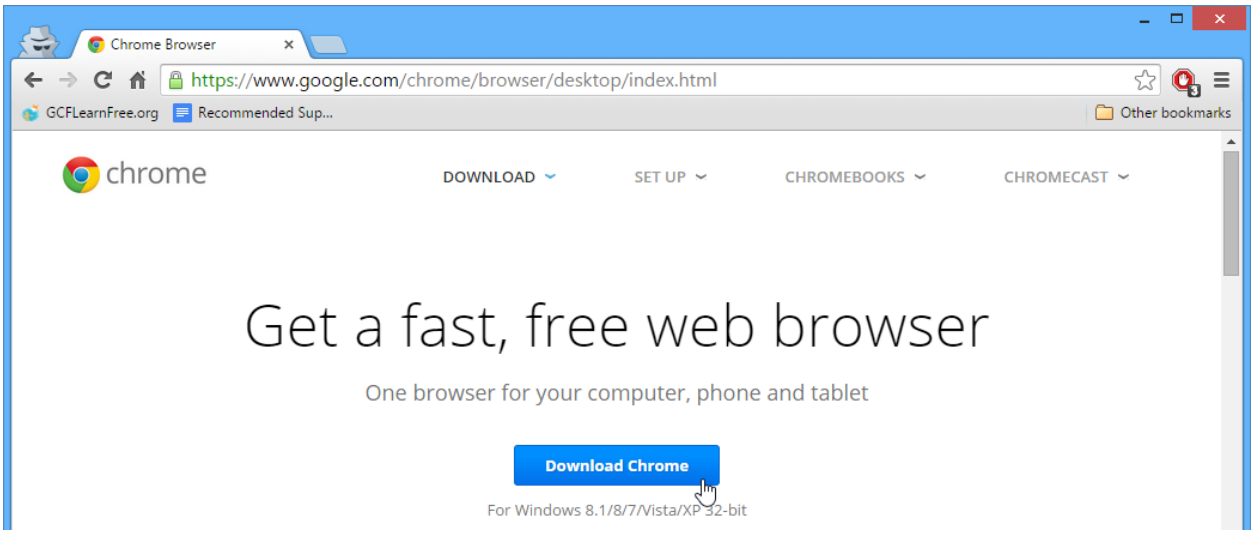
Now, practically all software has evolved away from this approach. Many new computers no longer feature a CD-ROM for this reason. However, if you do need to install software from a CD-ROM, just insert the disk into your computer, then follow the instructions.

Installing software via the Web

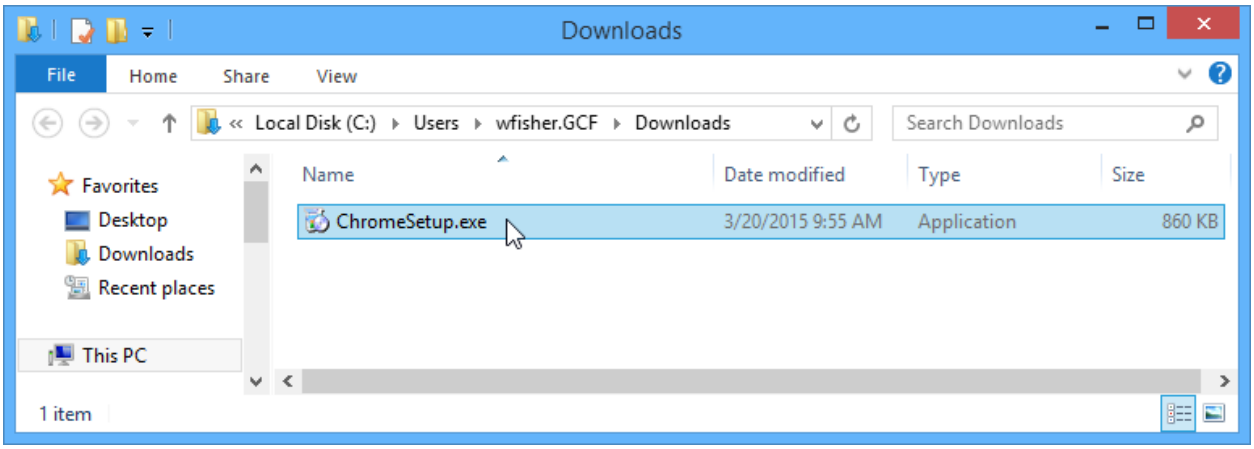
Today, the most common way to get new software is to download it from the Internet. Applications like Microsoft Office and Adobe Photoshop can now be purchased and downloaded right to your computer. You can also install free software this way. For example, if you wanted to install the Google Chrome web browser, you can visit this googlechrome.com and click the Download button.

The installation file will be saved to your computer in .exe format. Pronounced dot e-x-e, this is the standard extension for installation files on Windows computers. You can follow the steps below to install an application from a .exe file.

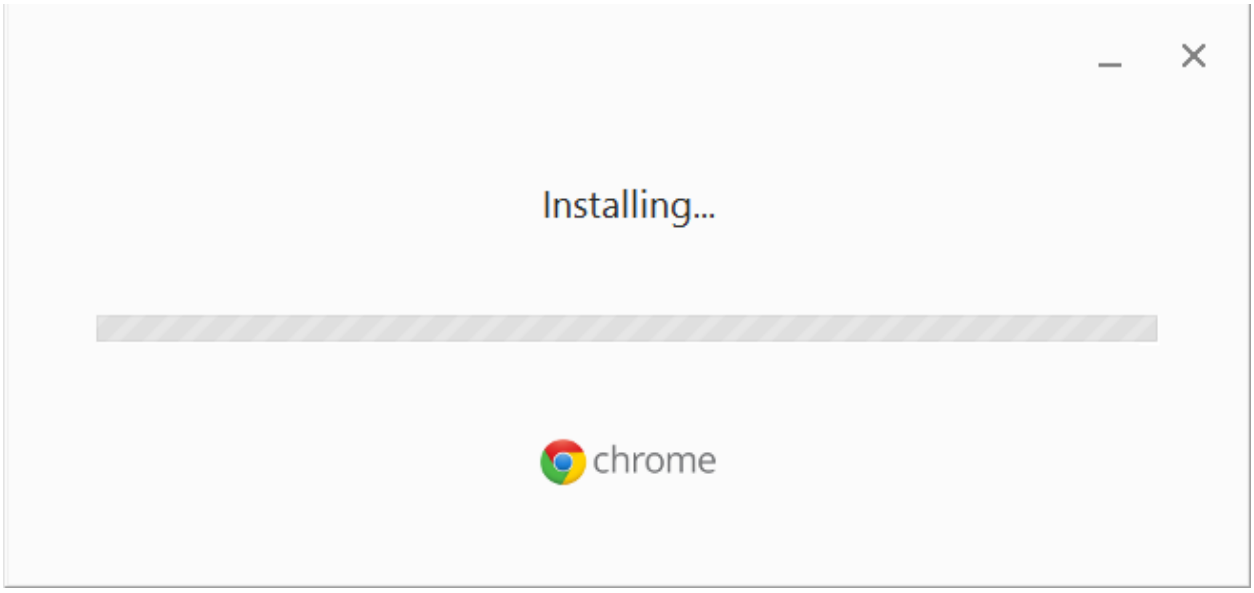
Locate and download a .exe file.



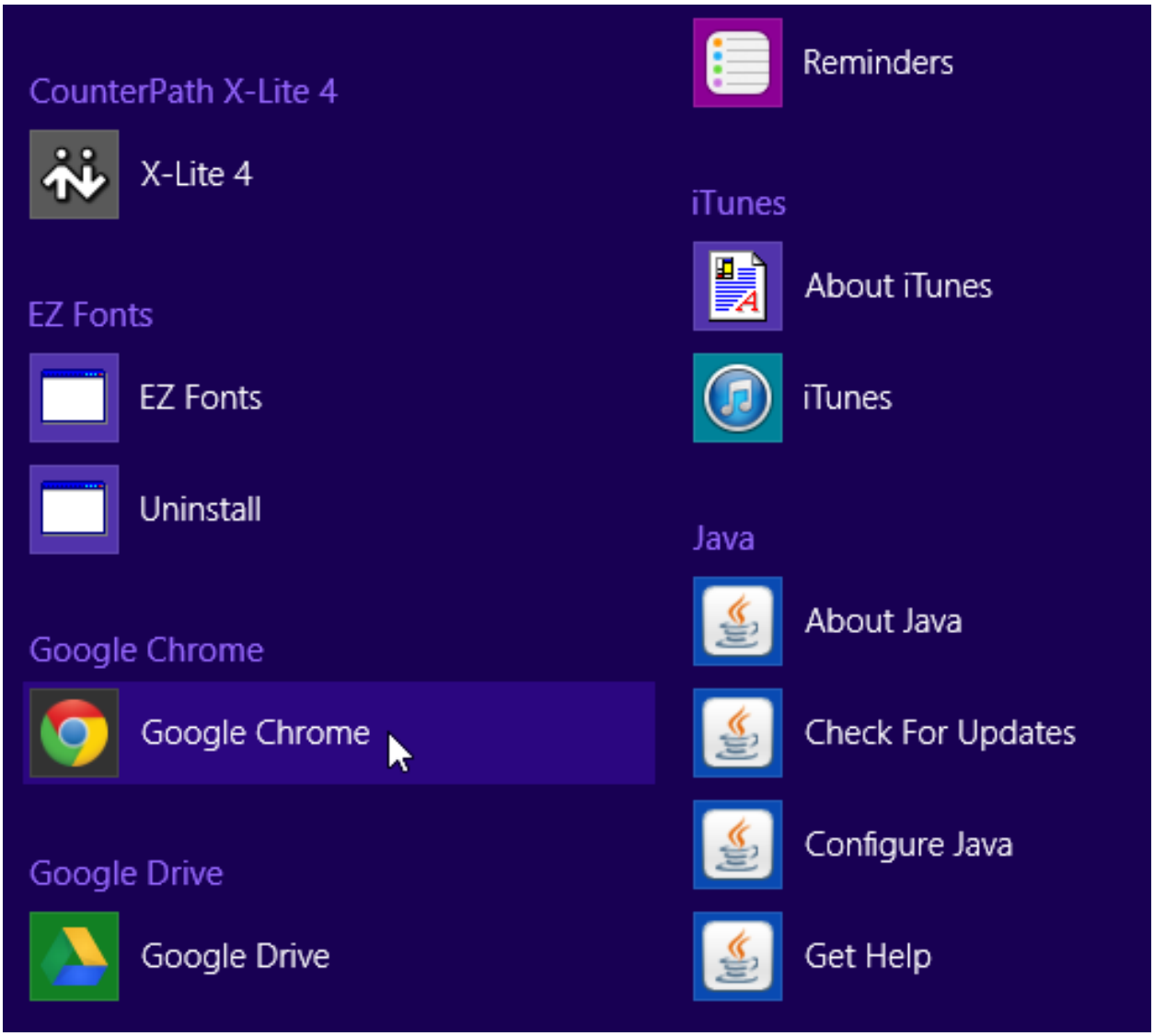
Locate and double-click the .exe file. (It will usually be in your Downloads folder.)



A dialog box will appear. Follow the instructions to install the software.



The software will be installed. You can now open the application from the Start menu (Windows 7) or the Start Screen (Windows 8).

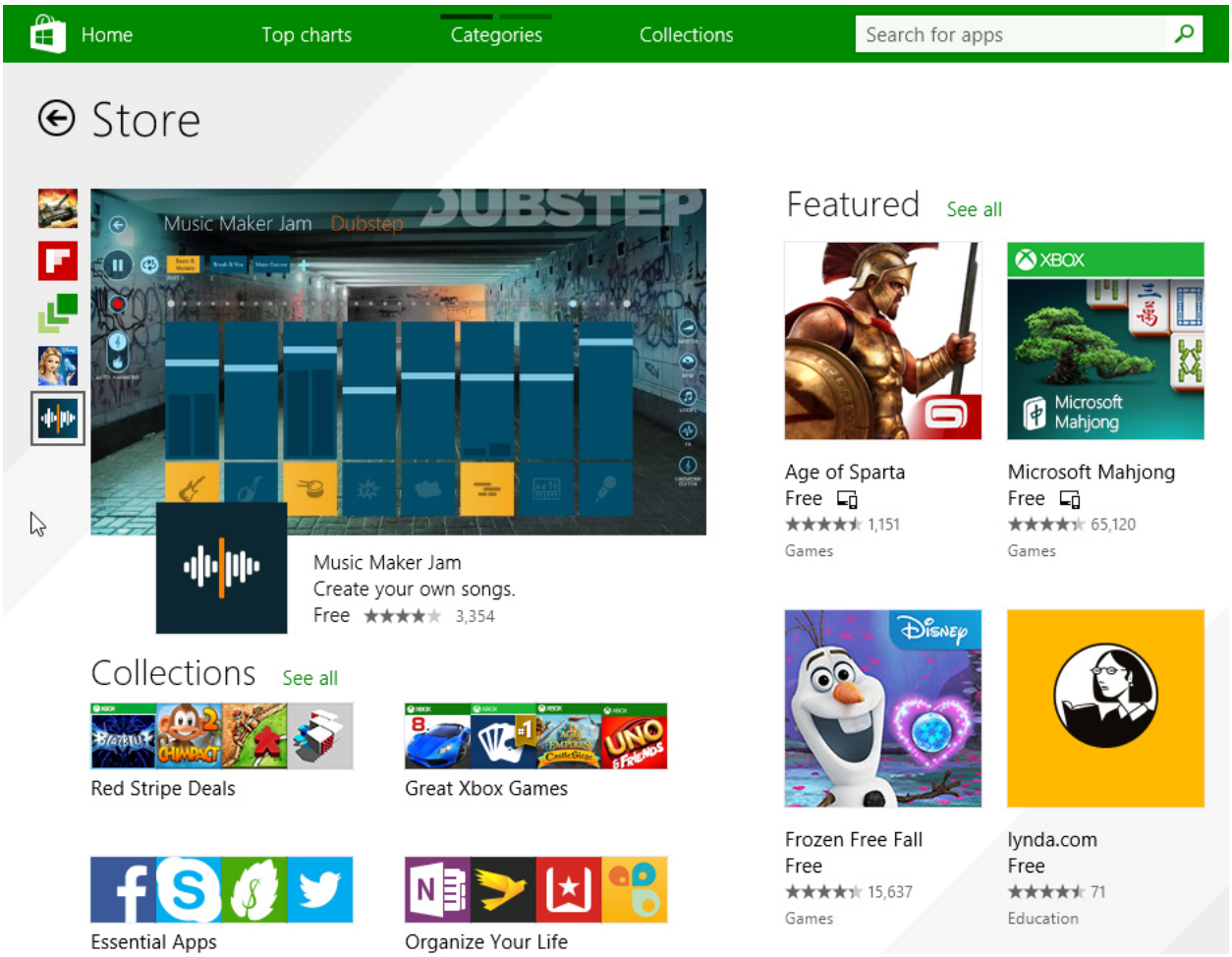


Tips for finding software

In our experience, the easiest way to find new software is to search the Web. For example, if you were looking for a way to edit some personal photos on your computer, you could run a Google search for free photo-editing software. If you're not exactly sure what kind of software you're looking for, try describing the tasks you want to complete. For example, if you wanted a way to create to-do lists and organize your appointments, you might search for something like free calendar organizer software.

The Windows Store

If you're using Windows 8, you can download and install software from the Windows Store. The Windows Store is meant to simplify the process of locating and installing software from third-party developers—when you find an app in the Windows store, you won't have to do any extra work to install it.



Source: https://media.gcflearnfree.org/content/5576fb04317fac09284750f1_06_09_2015/windows_store.jpg

Free software

There are free programs available for almost any purpose you can imagine. If you're looking for free software for a specific task or want to find a free alternative to an expensive commercial program, it's probably somewhere on the Internet. Often, the most difficult part is finding the safest, most reliable free programs among the thousands of other free programs.

Usually, the best way to find free software for Windows is to do an Internet search. On Android and iOS devices, the best way to find free software is to search in the Play Store or App Store for apps that are listed as free. For Mac OS, both the App Store and Internet searches are effective methods for finding free software.

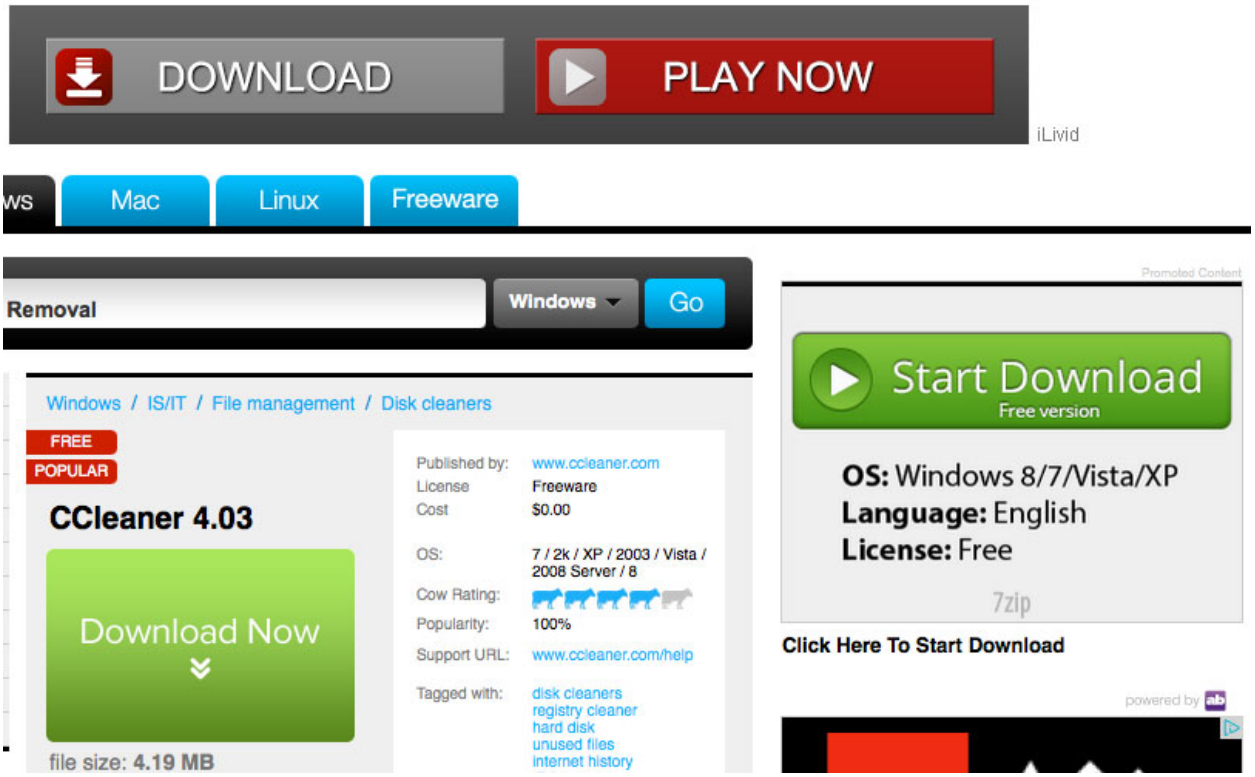
- When there is no fee to use software, it is sometimes called software gratis or freeware.

Safely searching for free software

When searching for free software, distinguishing good software from bad or dangerous software is crucial. These steps will help you find a program that is safe, reliable, and performs the functions you need.

- Identify your needs and the tasks you are trying to accomplish. Do you need a simple tool or something very powerful? Are you trying to perform a specialized task, or are you looking for something generally useful? Are you just looking to save money?
- Search for information on a program before downloading it. Determine if the publisher is reliable and well-liked, and if the program is safe and stable and has the features you want.

- Read reviews on neutral third-party sites; a publisher may remove negative reviews from its own site.
- Don't click misleading advertisements designed to look like download links or error messages. Carefully examine download links before clicking, or install an adblocker.
- Avoid malware included in installers. If an installer has options for custom search bars or other programs that seem unrelated, tell it not to install these.
- Download directly from the developer's website rather than from a third-party site. Many but not all third-party file hosting sites include malware with their installers.
- Scan for viruses and malware immediately after installing a new program. It's better to avoid installing malware, but scans will probably catch anything you missed.
- Misleading ads on a download page



Source: https://media.gcflearnfree.org/content/5576eaa0317fab09281031f1_06_09_2015/misleading-ads-2.jpg

In the image above, the download button at the bottom-left is the real download link, while the other two are misleading ads.

Keep in mind that these safety tips are good practices whether you're downloading free software or paying for software. There's nothing stopping a distributor from bundling malware with a program and still charging you a fee for it, and plenty of commercial software is unstable or

ineffective. Be aware at all times of common unscrupulous practices so you can avoid them and choose the best software for your needs.

Examples of free software

One of the biggest advantages of free software is determining your specific needs and searching for the program that's right for you, but sometimes it's helpful to see what software other people are using. Here's a list of some of our favorite free software for common tasks.

- Security and system optimization
- CCleaner: Optimization and storage management
- Malwarebytes: Anti-malware software

Productivity

- LibreOffice: A full-featured office suite
- Thunderbird: Email management software
- Keynote: Note-taking and organizational software
- Metapad: An advanced text editor
- Foxit Reader: A PDF viewer
- CutePDF: A PDF writer that works like a virtual printer

Media

- Paint.NET: A simple image editor
- GIMP: A complex and powerful image editor
- VLC media player: A cross-platform multimedia player
- K-Lite Codec Pack Standard: A multimedia player package
- Dropbox: Cloud storage, file synchronization, and file hosting

Why is some software free?

There are many reasons a developer may not be charging a fee for its software. In most cases, developers are still earning money through other means. Here are some of the common ways free software still makes money.

- **Donations:** The software is free, but users can donate money to support the developer.
- **Advertisements:** The developer is paid by other companies to place advertisements in the software or on its website.

- **Data mining:** The software collects information about users and sells this to advertisers or marketing researchers. This is often used in combination with advertisements.
- **Bundling other software:** Other software distributors pay the developer to bundle other programs with its software. This often includes malware.
- **In-app purchases:** The base software is free, but users can pay fees to unlock additional features.
- **Premium products or subscriptions:** The software itself is free, but the developer sells more advanced versions of the program or other programs.

Not all free software developers earn money from software. They may have full-time jobs and make software in their free time as a hobby, they may be working under a license that prohibits earning profit from the software, or they might just enjoy participating in free software communities on the Internet.

Some software is freely available because the developers adhere to certain social and ethical guidelines. This software is sometimes called software libre, although it's also sometimes called free software, using the definition of free that means liberty, not free of charge. You can read more about this type of free software at the Mozilla Foundation or the Free Software Foundation.

Support free software developers

After using free software for a while, if you are happy with the programs consider supporting their developers. Visit their websites, and look for ways you can help. They may have links for you to donate money, contribute your talents to their projects, or promote their software on social media. But remember, your support is a choice, not an obligation. Free software communities thrive on individual choice and mutual assistance.

4.5 Summary

Basic computer applications comprise a spectrum of software tools that boost productivity and communication in numerous sectors. Key regions include:

Internet and Web Browsing: Understanding web browsers and search engines is vital for efficient online research. Users should learn safe internet techniques and how to assess sources.

Email Applications: Email clients enhance communication. Users may send, receive, and organize messages, as well as manage files and contacts.

File administration: Organizing files into folders and knowing file types (e.g., .docx, .xlsx, .pptx) is vital for effective data administration.

Basic Troubleshooting: Knowledge of basic troubleshooting procedures helps users handle issues like poor performance or printing difficulties.

4.6 Assessment Questions

1. What are some best practices for conducting safe online research?
2. Explain the difference between a URL and a hyperlink.
3. What steps can you take to clear your browsing history?
4. How do you create a new email message and add a recipient?
5. What is the purpose of the CC and BCC fields in an email?
6. Describe how to organize emails using folders.
7. Why is it important to use folders to organize files?
8. What is the difference between saving a file and saving it as a different file type?
9. How do you rename a file on your computer?
10. What are some common reasons a computer might run slowly?
11. How can you troubleshoot a printer that is not responding?

Module 2: Introduction to Basic Programming

Unit 5: Concept of System Development Cycle & Program Development

Flow of the Unit

5.0 Objective
5.1 Introduction
5.2 Description of SDLC
5.3 Description of each Stage of SDLC
5.4 Summary
5.5 Assessment Question
5.6 Reference

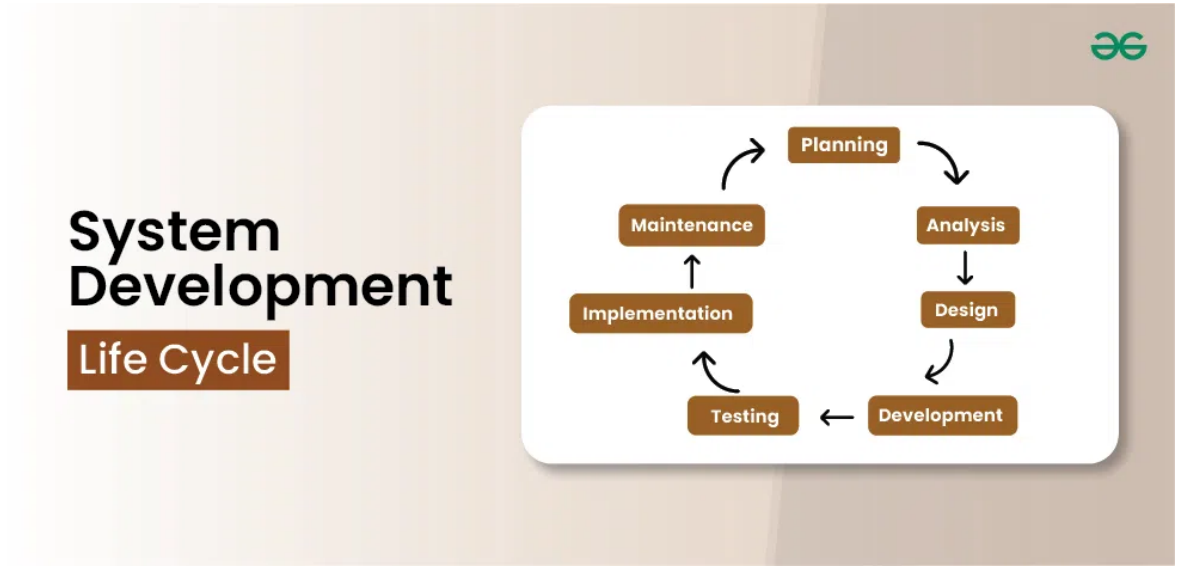
5.0 Objective

a. Describe System Development Life Cycle (SDLC).
b. Able to describe each stage involve in implementing SLDC.
c. Identify stages involve in SDLC

5.1 Introduction

The system development life cycle (SDLC) takes a project through from the first concept or invention to the point when it becomes a working system. It is a basic part of the approach which is employed while defining a project.

The System Development Life Cycle (SDLC) offers a well-structured framework that gives an idea, of how to design a system. It includes of stages as follows - Plan, Analyze, Design, Develop, Test, Implement and Maintain. In this post, we will explore all the phases of system development.



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5.2 Description of System Development Cycle

The System Development Life Cycle (SDLC) approach applies to information system development projects guaranteeing that all functional and user requirements and agency strategic goals and objectives are accomplished. The SDLC offers a defined and standardized methodology for all stages of any system development project. These phases track the development of a system through several developmental stages from feasibility analysis, system planning and concept development; to acquisition and requirements definition; design; development; integration and testing; deployment and acceptance; though deployment and production; and finally to system retirement or maintenance.

Stages in System Development Cycle

i. Preliminary study
ii. Feasibility study
iii. Investigative study
iv. Analysis
v. Design
vi. Implementation
vii. Maintenance
viii. Study review

5.3 Description of Each Stage of System Development Cycle

i. Preliminary study:

Preliminary system research is the initial step of system development life cycle. This is a quick analysis of the system under discussion and offers a clear image of what exactly the physical system is. In reality, the first system study comprises the production of a System proposal which contains the Problem Definition, Objectives of the Study, Terms of reference for Study, Constraints, Expected advantages of the new system, etc. in the light of the user needs. The system proposal is generated by the System Analyst (who examines the system) and brings it before the user management. In summary, we would say that system research phase proceeds through the following steps:

- Issue identification and project beginning
- Background analysis

- Inference or findings

ii. Feasibility study:

After the system idea is approved by the management, the following process is to analyze the practicality of the system. The feasibility study is simply the examination of the proposed system in the light of its workability, satisfying user's needs, efficient use of resources and of course, the cost effectiveness. These are characterized as technical, operational, economic, timetable and social feasibility. The fundamental purpose of feasibility study is not to solve the issue but to reach the scope. In summary, following choices are made in various feasibility study:

Economic feasibility - The probable benefits exceed the expense of fixing the issue which is often proved by a cost/ benefit analysis.

- **Operational feasibility**: Whether the issue can be addressed in the user's environment with current and planned system workings?
- **Organizational feasibility**: Whether the suggested system is compatible with the organization's strategic objectives?
- **Technical feasibility**: Whether the issue be addressed using current technology and resources available?
- **Social feasibility**: Whether the problem be handled without producing any social issues? Whether the system will be acceptable to the society?

iii Investigative study:

The full research of the system is carried out in line with the goals of the proposed system. This entails extensive examination of numerous processes conducted by a system and their interactions inside and outside the system. During this procedure, data are gathered about the accessible files, decision points and transactions handled by the existing system. Interviews, on-site observation and questionnaire are the instruments to be utilized for thorough system research. Using the following stages it becomes easier to design the precise border of the new system under consideration:

- Keeping in mind the difficulties and new needs
- Workout the positives and downsides involving new regions of the system

All the data and the conclusions must be recorded in the form of detailed data flow diagrams (DFDs), data dictionary, logical data structures and micro specifications. It involves planning for

the new system, analysis of need, system limitations, functions and suggested system architecture, prototype of the proposed system and its analysis.

iv Analysis:

Systems analysis is a method of gathering factual data, understand the processes involved, finding faults and proposing practical solutions for enhancing the system functioning. This comprises analyzing the business processes, acquiring operational data, comprehending the information flow, seeking out bottlenecks and generating solutions for overcoming the shortcomings of the system so as to fulfill the corporate objectives. System Analysis also comprises subdividing of complicated process involving the complete system, identification of data storage and manual operations.

The primary aims of systems analysis are to identify solutions for each business process:

What is being done?

How is it being done?

Who is doing it?

When is he doing it? Why is it being done?

How can it be improved?

It is more of a thinking process and utilizes the creative talents of the System Analyst. It seeks to give birth to a new efficient system that serves the present demands of the user and provides space for future expansion within the organizational restrictions. The conclusion of this procedure is a logical system design. System analysis is an iterative process that continues until a preferred and accepted solution emerges.

v. Design:

Based on the user requirements and the complete study of a new system, the new system must be created. This is the phase of system designing. It is the most essential step in the development of a system. The logical system design arrives at as a consequence of system analysis and is turned into physical system design. In the design phase the SDLC process continues to move from the, what questions of the analytical phase to the how. The logical design developed during the analysis is translated into a physical design - a precise description of what is required to address the issue. Input, output, databases, forms, codification systems and processing requirements are worked out

in detail. In the design stage, the programming language and the hardware and software platform in which the new system will run are also determined. In the design step, logical design is turned into computer programming codes after which testing is done to verify a functioning system

Coding

The system design has to be executed to make it a working system. This necessitates the coding of design into computer language, i.e., programming language. This is also termed the programming phase in which the programmer translates the program requirements into computer instructions, which we refer to as programs. It is a crucial step when the described processes are translated into control specifications with the assistance of a computer language. The programs coordinate the data motions and govern the complete process of a system.

Testing

Before really incorporating the new system into operations, a test run of the system is done eradicating all the problems, if any. It is a key step of a successful system. After codifying the full programs of the system, a test plan should be designed and conducted on a specific set of test data. The output of the test run should match the anticipated findings. Sometimes, system testing is seen as a component of implementation process.

Using the test data following test run are carried out:

- Programtest
- Systemtest

Program test: When the programs have been developed and compiled and brought to working conditions, they must be individually tested using the provided test data. All verification and validation be reviewed and any unpleasant event must be reported and debugged (error fixed).

System Test: After carrying out the program test for each of the programs of the system and faults eradicated, then system test is done. At this level the test is done on real data. The full system is operated on the real data. At each level of the execution, the outcomes or output of the system is examined. During the result analysis, it may be noticed that the outputs are not matching the predicted output of the system. In such situation, the flaws in the individual programs are found and are rectified and further checked for the intended outcome.

vi Implementation:

After having the user acceptability of the new system built, the implementation phase starts. Implementation is the stage of a project during which theory is converted into practice.

The primary tasks involved in this phase are:

- Acquisition and Installation of Hardware and Software
- Conversion
- User Training
- Documentation

The hardware and the associated software needed for operating the system must be made fully operational before installation. The conversion is also one of the most significant and costly processes in the system development life cycle. The data from the old system has to be transformed to work in the new format of the new system. The database has to be created with security and recovery processes clearly outlined.

During this step, all the programs of the system are loaded into the user's computer. After loading the system, training of the user commences. Main themes of such sort of training are:

- How to run the package?
- How to input the data?
- How to process the data (processing details)?
- How to take out the reports?

The documentation of the system is also one of the most significant activities in the system development life cycle. This assures the continuance of the system. Generally following two sorts of documentations are generated for every system.

- User or Operator Documentation
- SystemDocumentation

vii. Maintenance:

Maintenance is important to eradicate mistakes in the system throughout its working life and to adjust the system to any alterations in its operating surroundings. It must fit the scope of any future upgrade, future functionality and any other new functional elements to cope up with the latest future necessities. It has been noticed that there are always some mistakes identified in the systems that must be recorded and remedied. It also entails the evaluation of the system from time to time. The evaluation of the system is done for:

- Understanding the complete capabilities of the system
- Knowing the needed adjustments or the extra requirements
- analyzing the performance.

- If a big modification to a system is required, a new project may have to be established up to carry out the change. The new project will then progress through all the aforementioned life cycle stages.

2.8 Summary

System Development Life Cycle (SDLC): A procedure for designing, building, testing, and deploying information systems. It comprises processes such as requirements gathering, design, implementation, testing, and maintenance.

Program Development: This encompasses the methodical process of generating software, including identifying goals, coding, testing, and documentation.

2.9 Assessment Questions

1. System Development Cycle and Program Development
2. Describe the steps of the System Development Life Cycle (SDLC).
3. What function does documentation play in software development?

Module 3: Introduction to Basic Programming

Unit 1: Basic Computer Operation and Application Areas of Computer

Flow of the Unit

1.0 Objective
1.1 Introduction
1.2 Basic Computer Operation
1.3 Application Areas of Computer
1.4 Summary
1.5 Assessment Question
1.6 Reference

1.0 Objective

a. Describe Basic computer operation
b. Identify all I/O devices and their functions
c. Describe major application areas of computer
d. Understand the features of computer

1.1 Introduction

The name computer was borrowed from the Greek word compute implies calculation and the computer was a person or equipment that accomplished computation. In this post, we will understand what precisely a computer is, how it influences our lives, and the uses of computers in our life.

What is a Computer?

A computer is a machine used to process data or information and conduct mathematical and logical calculations. Modern computers perform a wide range of tasks, store retrieve, and process information. Using a computer we can create/modify papers, send/receive emails, read information on the internet, and play video games. After the development of computer science and technology grew too sophisticated. Today we can not image increasing our technologies without computers.

Components of the Computer System

The many components of the computer system are categorized into two categories. Hardware Software

1. Hardware

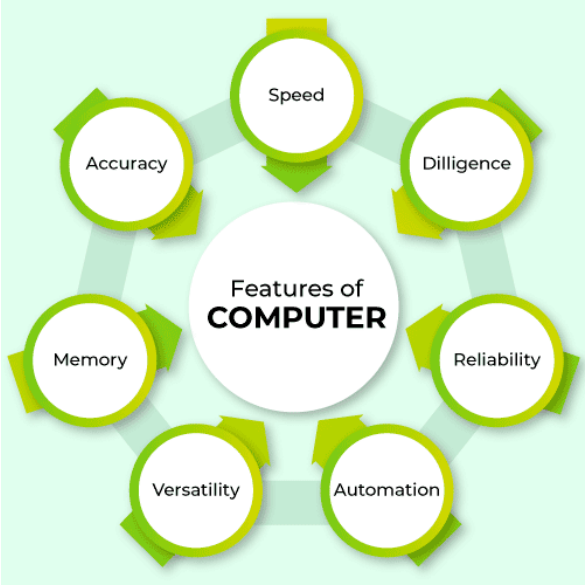
Hardware is the physical tangible component of the computer system. This sort of component is touchable. CPU, Mouse, Keyboard are examples of hardware components. So, the hardware of the computer system are:

- **Input Device:** Input devices enable the user to input data/information in the CPU (Central Processing Unit). Mouse, Keyboard, scanner, barcode reader are common examples of input devices.
- **Output Device:** Output devices input the processed data/information into human-readable form. Monitor, speaker, projector, printer are common examples of output devices. **Central Processing Unit (CPU):** The CPU is referred regarded as the brain of a computer system. It is used to processed data/information and delivers output to output devices. The CU (control unit), ALU (arithmetic and logical unit), and registers are components of the CPU.

  Storage: In a computer, storage devices are used to store the data or information that came into the computer system and the output comes from processing the information or data.

2. Software

Software is a collection of programs (set of instructions), data, and protocols. It is not in material form hence we can not touch such sorts of components. The execution of software programs is accomplished by hardware. Firmware, operating systems, applications are examples of software. Now we will examine the features of the computer:



Features of Computer

i. **Speed:** A computer is a time-saving instrument. It executes various computations and activities in few seconds that humans take hours to solve. The speed of a computer is measure in units of GigaHertz and MegaHertz.

ii. **Accuracy:** A computation or operation done by a computer is accurate the odds of occurring mistakes are negligible. The mistakes arise in a computer by inputting erroneous data by a human being. A computer conducts various jobs and computations so rapidly and precisely.

iii. **Memory:** A computer can store billions of records as per necessity and these data are be accessed with complete correctness. The storage capacity of computer memory is measured in terms of Bytes, Kilobytes (KB), Megabytes (MB), Gigabyte(GB), and Terabyte(TB).

iv. **Versatility:** A computer can accomplish more than one work at the same time, this capability is called versatility. For example, we can build our project using PowerPoint and Wordpad while listening to music or we may design a website while listening to music.

v. **Automation:** Today the world is heading toward AI (Artificial Intelligence) based technologies. Once instructions are written, a computer may conduct tasks automatically. This function of the computer replaces thousands of labor by executing jobs automatically.

vi. **Reliability:** A computer is a dependable equipment. The output results never alter unless the input is different. If an input is the same then result won't be different.

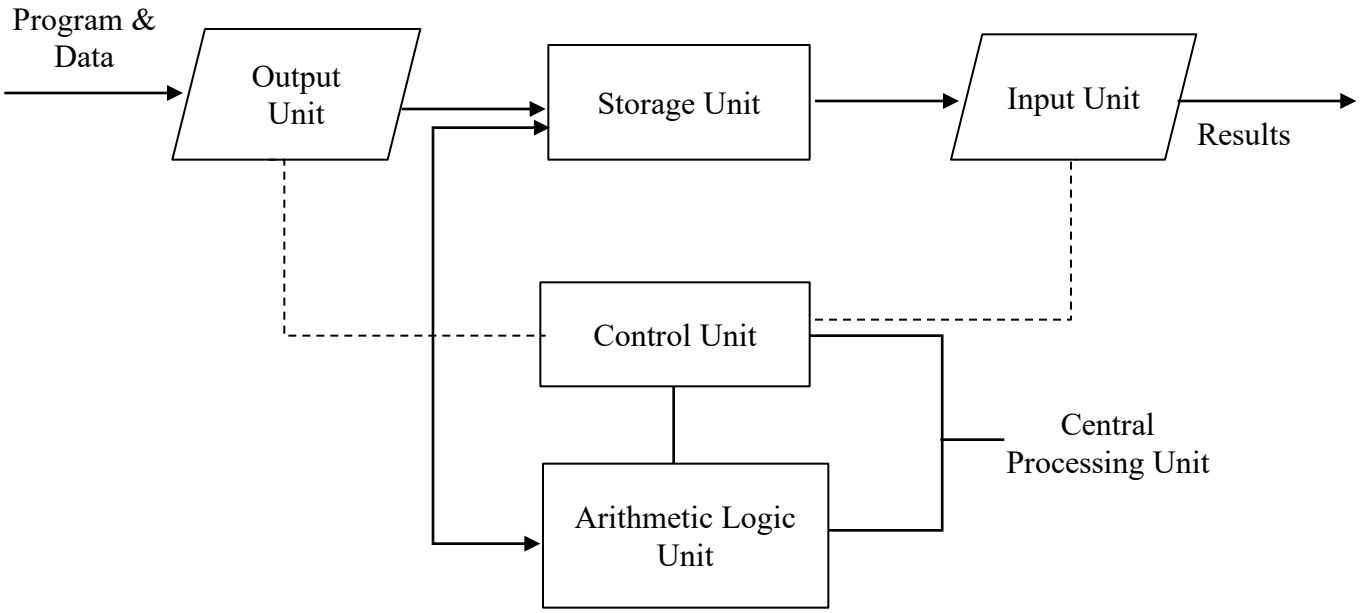
vii. **Diligence:** A person can not work for many hours without taking a break yet a computer gadget never gets weary. A computer can run millions of computations continually with complete precision without taking a pause.

1.2 Basic Computer Operation

A computer as shown in diagram below performs basically five major operations or functions irrespective of their size and make. These are

1. It accepts data or instructions by way of input,
2. It stores data,
3. It can process data as required by the user,
4. It gives results in the form of output, and
5. It controls all operations inside a computer. We discuss below each of these operations.

1. Input: This is the process of entering data and programs in to the computer system. You should know that computer is an electronic machine like any other machine which takes as inputs raw data and performs some processing giving out processed data. Therefore, the input unit takes data from us to the computer in an organized manner for processing.



Computer Basic Operations

2. Storage: The technique of preserving data and instructions permanently is called as storage. Data needs to be input into the system before the real processing occurs. It is because the processing speed of the Central Processing Unit (CPU) is so quick that the data needs to be given to the CPU with the same speed. Therefore, the data is initially saved in the storage unit for quicker access and processing. This storage unit, or the core storage of the computer system, is meant to accomplish the aforementioned functions. It offers room for storing data and instructions.

The storage unit performs the following primary functions:

- All data and instructions are saved here before and after processing.
- Intermediate outcomes of processing are also saved here.

3. Processing: The job of completing operations like arithmetic and logical operations is termed processing. The Central Processing Unit (CPU) collects data and instructions from the storage unit and does all types of computations depending on the instructions supplied and the type of data presented. It is then shipped returned to the storage container.

4. Output: This is the process of obtaining outcomes from the data for gaining relevant information. Similarly, the output generated by the computer after processing must likewise be preserved someplace within the computer before being presented to you in human-readable form. Again, the output is also retained within the computer for further processing.

5. Control: The way in which instructions are executed and the aforesaid actions are completed. Controlling of all processes including input, processing, and output is accomplished by the control unit. It takes care of the step-by-step processing of all actions on the computer.

Data Representation

The fundamental building block of personal computers is the transistor. A transistor is an electronic device for regulating the flow of electrons in an electrical circuit. If electrons are permitted to flow, the circuit is on; conversely, if electrons are not allowed to flow, the circuit is off. Thinking of a transistorized circuit as a switch like a light switch at home. The switch is either on or off and remains that way until it is flicked again. When a circuit is on, we say it is in the marking state and assign a 1 to it. Conversely, when it is off, we give a 0 to it.

A contemporary digital computer is sometimes stated to be a binary computer since its most basic circuitry can remember either one of two states: 0 or 1. The binary digits 0 and 1 are called bits. Both the internal and external memory of a computer are nothing more than storehouses for bits.

1.3 Application Areas of Computer

Computers are employed in every sphere of life, such as families, companies, educational institutions, research organizations, the medical industry, government offices, entertainment, etc. Today we can not image increasing our technologies without computers. The many field where the computer is highly vital are:

Science

Today computer is the key work tool in the area of science. It is the best-suited machine for gathering, processing, categorizing, and storing data. It becomes the most crucial medium to transmit information internally and worldwide. It enables scientists from various places to work together and exchange ideas on the same subject.

Defence System

A computer performs a critical to control defensive system. Computers are used to monitor aircraft, missiles, tanks, and many sorts of weaponry. Once the radar system monitors a missile and artificial intelligence is taught to target a missile and destroy it before it gets on the surface. It also utilized for GPS monitoring, managing defense vehicles, records of all personnel of the military.

Medical

The computer plays a very vital function in medical research such as record patients' information monitoring heart rate, oxygen level, and blood pressure. To execute different procedures young physicians obtain the aid of another expert doctor using online conferencing. Research is also disseminated with the use of computers in the health industry.

Education

Today learning gets simple due of technology. Anyone working or student may learn any stage of life with the use of a computer. Computers are highly vital for online courses, get study material on the internet. Computers are also utilized to monitor student attendance and learning techniques. Coaching and institutions enlarged their areas by audio-visual aids employing computers.

Banking

A computer serves a key part in banking sectors, by keeping many account holder data on a bank server. All transactions such as deposits and withdrawals perform by a computer. A financial organization can effortlessly monitor all ATMs and passbook producing equipment.

Government Sectors

Government may simply monitor government sectors such as road services, railway, development, and other increasing finances. The information of every citizen is kept on the server via the computer.

Entertainment

Today most individuals are so busy and they can not easy obtain time to renew their thinking. We can play different intriguing video games utilizing a computer. We may view movies, TV series, and reality shows on the computer. A computer is also used to produce caustic memes and make us smile.

1.4 Summary

This unit covers the fundamental concepts of computer functioning, including hardware components (CPU, memory, storage), software kinds (system and application software), and the basic operations of operating systems. It studies how these components combine to complete tasks effectively.

1.5 Assessment Questions

1. Explain the distinction between hardware and software in a computer system.
2. List three main functions of an operating system.
3. Describe how computers have influenced the sector of education. Provide two concrete instances.
4. Discuss the relevance of computers in corporate operations today. Include examples of how they enhance productivity and decision-making.
5. Analyze the function of computers in scientific inquiry and engineering. How do they contribute to innovation in these fields?
6. Evaluate the possible ethical consequences of employing computers in healthcare. What are some risks connected to data privacy and security?

Module 3: Introduction to Basic Programming

Unit 2: Managing Computer Files

Flow of the Unit

2.0 Objective
2.1 Introduction
2.2 Basic Concepts of File Management
2.3 Organizing File and Folders
2.4 Creating & Naming Files and Folders
2.5 File Types
2.6 Summary
2.7 Assessment Question
2.8 Reference

2.0 Objective

a. Explain the importance of file management
b. Find a file path and find a file using a file path
c. Distinguish between a file and a folder
d. Explain the importance of using the correct file-naming conventions.
e. Organise, copy, rename, delete, restore, and move files and folders.
f. Search, view, and sort files and folders.
g. Describe the different file types and their extensions.

2.1 Introduction

We will begin this lesson by defining several terms associated with file management. Comprehending these words is essential for effectively organizing and locating the data you use on your computer.

File Management: The systematic process of establishing an ordered framework for the storage of information to facilitate efficient retrieval.

A drive is a storage device for computers that retains information. It is the primary place, known as the "Root" directory, for file storage. Drives are frequently assigned a letter, such as C:\, which usually represents the computer's primary hard disk. Additional examples of drives include the campus network drive (designated as the Z:\ disk) and external USB drives, such as Flash or Thumb Drives. The drive letters differ based on the machine in use.

A folder is a storage unit inside a disk. Another word for a folder is a "dirfolder exampleectory", yet the term "folder" has been the term of choice for most. A folder may contain files or other directories, referred to as "subfolders." Users can create folders that accommodate their method of

organization. For example, you may want to keep all of your work for your English course in a certain place of your computer to make it simpler for you to discover.
To achieve this you may create a folder on your C:\ drive titled "English" and then inside the "English" folder create two more subfolders -- One for Papers and one for Journals. The folder structure would look like the one to the right.

File: A file may be a document, spreadsheet, picture, or other form of thing that is kept on a computer. Files are often connected with a program or software application that is required in order to access the item.

File Extension: The file extension occurs after the period in the filename and is used to signify the kind of format the file is in. For example the file extension ".docx" indicates that the file is a Microsoft Word document. A full filename utilizing this extension may look like this: "Letter to Mom.docx"

Path: The path refers to the actual location of the file and communicates to the computer user the full sequence that must be followed to discover the file. The path starts with the disk and then contains any folders or subfolders that store the file. In the example above, a Microsoft Word document called "paper1.docx" that is kept in the "Papers" folder would have the path: C:\English\Papers\paper1.docx.

File Management Utility: A File Management Utility is a computer application that offers a user with a graphical interface in which he/she can manage files and directories on a computer's storage drive.

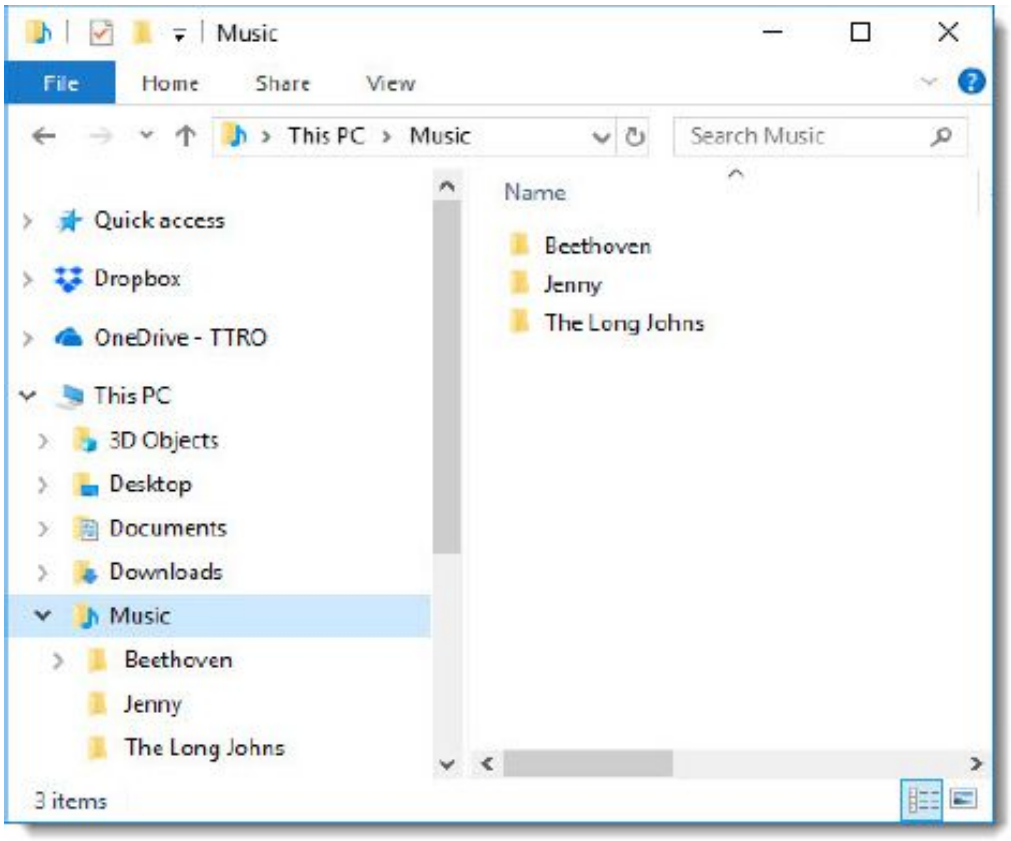
Zipping (Compressing): Zipping is the process of packing a folder that includes numerous files into a single file (called a "Compressed" or "Zipped" folder). In addition to consolidating many files into one, the resultant zipped folder often takes up less storage space. Knowing how to zip files is extremely essential when you need to distribute several files to someone else (example: by email or an online course). A Zip folder has a ".zip" file extension and the symbol for the zip folder

often looks like a folder with a zipper. In order for the receiver to see the files, they would first need to unzip (or Extract) the zipped folder to be able to access the individual contents within.

2.2 Basic Concepts of File Management

File management on a computer is analogous to filing papers in a file cabinet. A filing cabinet is used to hold paper files in cardboard folders. In the same manner, we may store files and directories on a computer.

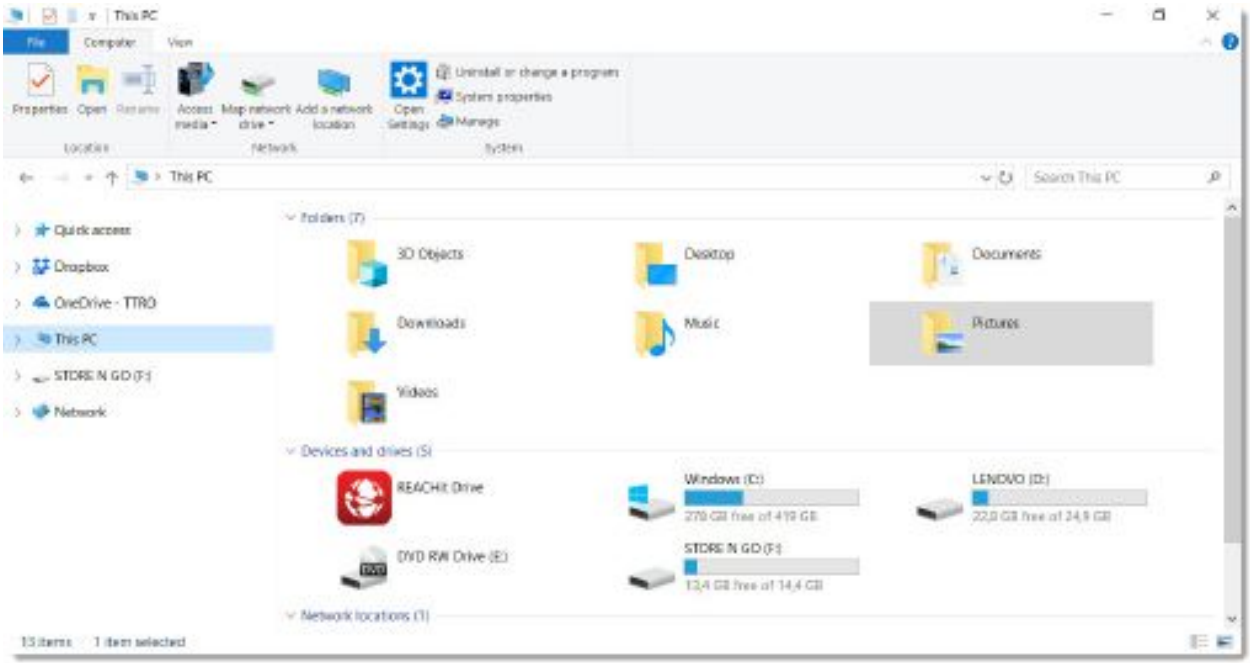
Figure illustrates the This PC folder with the sub-folder Music. This folder includes sub-folders that are sorted according to the name of the artist or group. This is to give you an idea of how file management appears on a computer. In Windows, folders are used to organize files.



Folders used for file management

Folders are kept on a disk of a computer. Data is stored on and retrieved from a disk drive. Each drive will display the kind of storage media, for example, whether it is a hard disk, USB drive,

CD, DVD, or so on. Figure displays an example of the various disks that may be found on a computer.



Different storage media on a PC

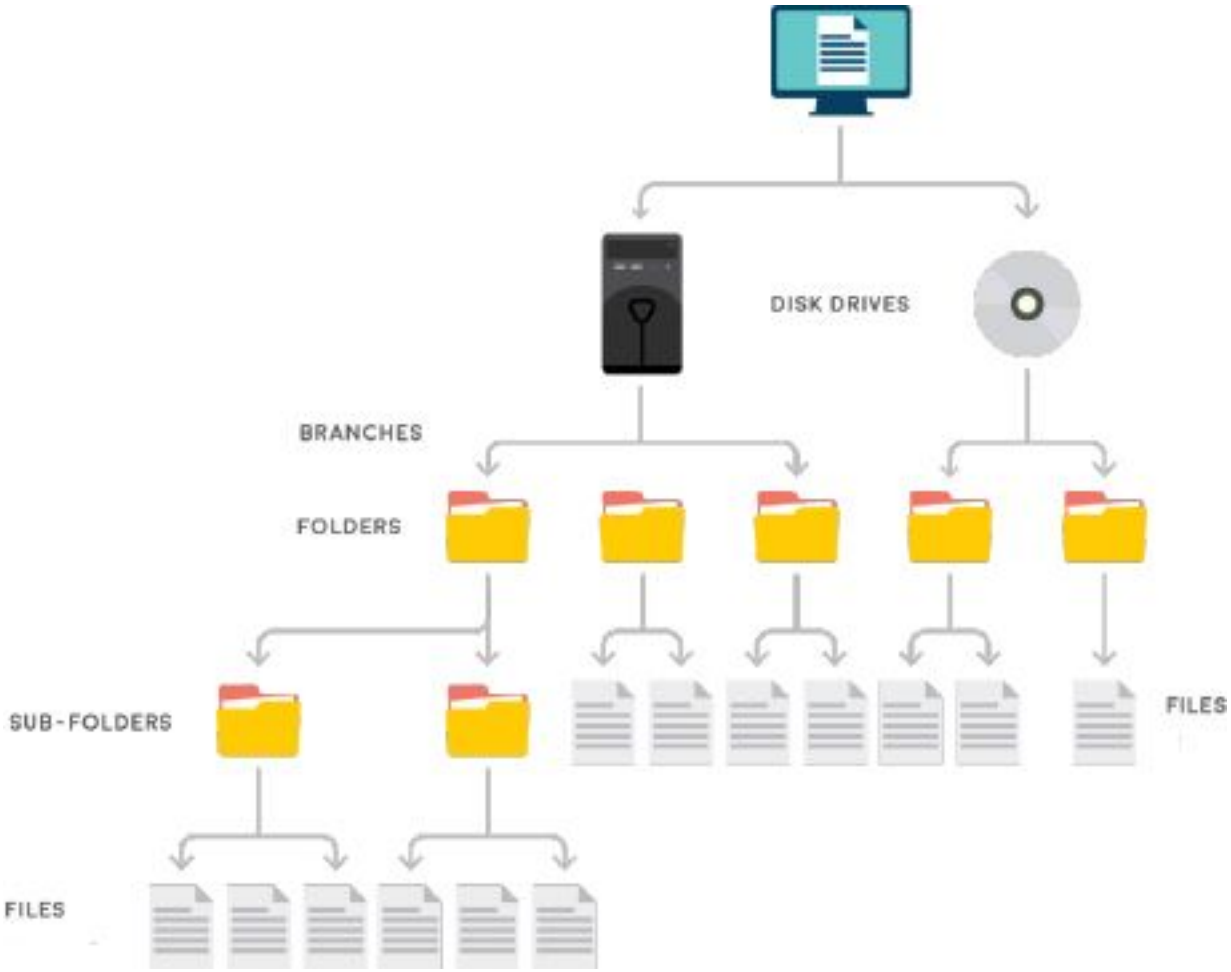
The capital letters and colon show what sort of disk it is. For example, from Figure above, you can observe the following:

- **The C:** Which is sometimes known as the C-drive, generally refers to the hard disk drive (HDD).
- **The D:** Which is also known as the D-drive, generally refers to a CD or DVD drive. Other letters are sometimes used to denote storage media, for example, in this instance F:, which refers to a detachable drive (USB). Storage media, such as DVDs, USBs and hard drives, do not store data to the disks on the computer.

Folders

A Windows operating system arranges its disks, folders and data in a hierarchical folder structure. Files are saved on a computer within folders. Folders are used to arrange a computer's files so that it can be discovered easily. A folder will contain sub-folders and then files.

In the next example, we will describe a folder by comparing it to a tree. The structure is the form of a pyramid, where each row of objects is connected to the ones underneath it. Because of its pyramidal construction, this hierarchical arrangement is sometimes known as a "inverted tree".



Hierarchical tree

The various drives, such as the different hard drives, CD/DVD drive, USB drives, as well as network drives, are located on the row below the root. Folders related to the individual drives are then listed in the following row.

Any sub-folders and files discovered in the folder above are listed in the following row. This pattern continues until the last row only includes files.

The top level of the tree structure of a drive is, thus, termed the root directory and is kept on the hard-disk drive of a computer. The papers then create a sub-folder of the root directory C-drive, which is denoted as C:\.

File Path

A file path displays the location of where a file, web page, or other thing is located on the computer. The file path displays you to which storage device the file is stored (i.e. the drive letter), in which

folder and sub-folders the file is saved, the name of the file and lastly, the kind of file (provided by the file extension).

For example, Jane has a music folder where she puts her tunes. Figure displays an example of this file path.

Example of file path

As Figure indicates, each file's unique file path begins with the storage device drive letter. After the drive letter, you will notice the name of the file's folders and sub-folders. A back slash (\) is used to divide the drive letter, and the individual folders and files. Finally, the file path concludes with the name and extension of the file.

Windows file names include two parts; the first part is the file name and then a period followed by an extension. A file extension or file name extension is situated at the end of a file name and identifies what sort of file it is in Microsoft Windows. The extension is a three- or four-letter shorthand that specifies the kind of file. For example, in the file name, Moonlight.mp3, the extension is mp3.

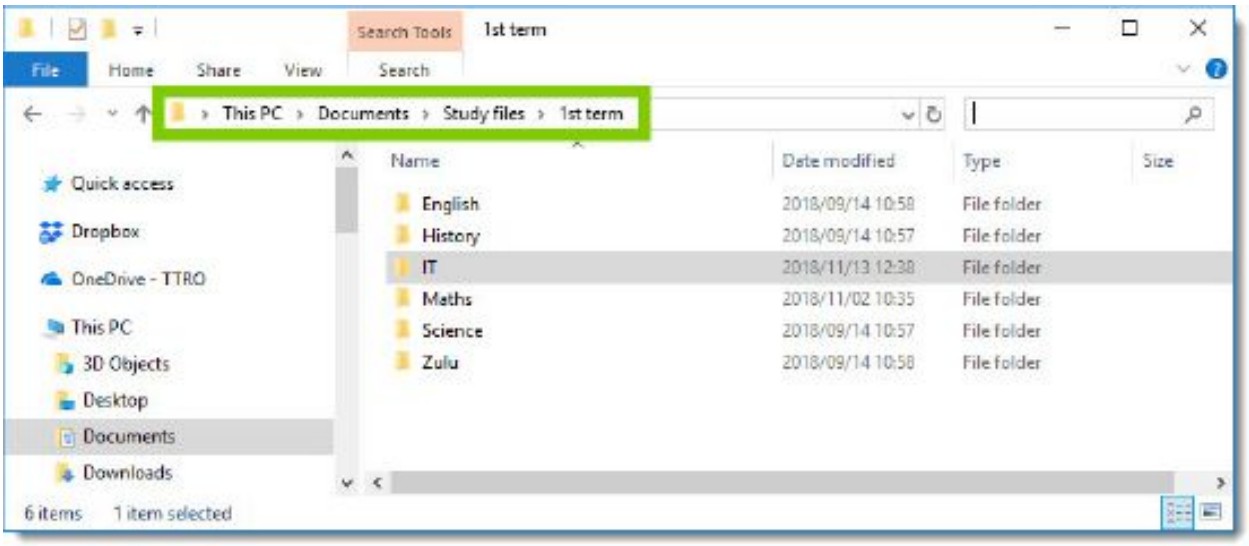
Finding A File Path

To discover the file path of a folder, click on the address bar in File explorer.

Guided Activity 1

You may accomplish this as follows:

1. Open the Computer window from the Start menu.
2. Browse to the folder for which you want the file location.
3. Click on the address bar to view the folder's address.

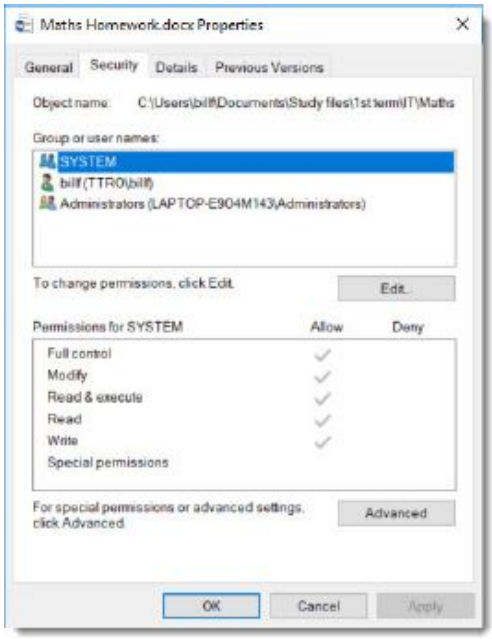


Address bar

Guided Activity 2

If you want to know what a file's unique file path is, you can discover it using the Properties window.

1. Open the computer window from the Start menu.
2. Look for the file you want the file path for.
3. Right-click on the file and pick the Properties option.
4. Click on the Security tab.
5. The file path is shown at the top of the security tab as the Object name.



Reading a file path from the properties window

2.3 Organising Files and Folders

Organising files on your computer is a crucial chore, since it may eventually save you loads of time and work! For you to discover files and folders on the computer, it must be arranged appropriately. It is, therefore, vital for you to store files in folders and give them the right names. In Microsoft Windows, this may be done in numerous ways. This section will look at the simplest methods in which files may be copied, moved across directories, renamed, and removed. You will also learn about how to search for files on a computer.

Before you can start arranging your computer, you first need to check how the computer is now structured.

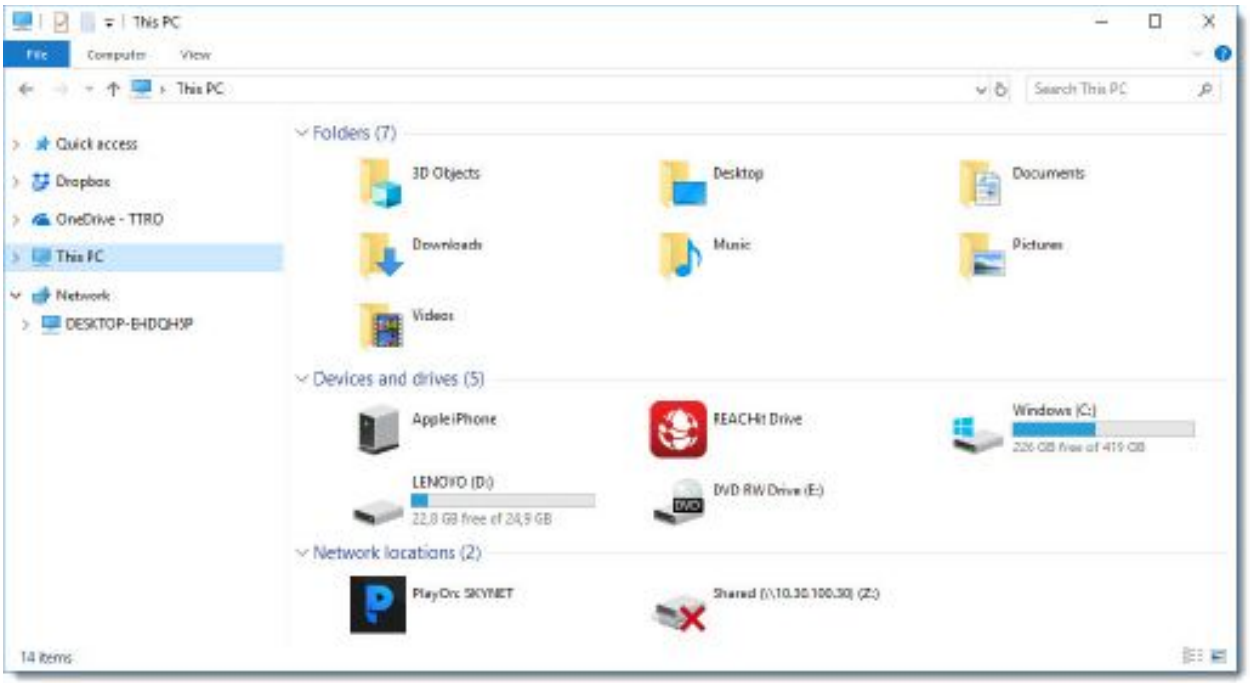
Using A File Manager (This Pc)

A file manager is a built-in tool that is used to arrange files and directories. To open the file manager, double-click on the This PCicon. The This PC folder will open up in a new window. From here, you may start working with the files and directories.

Guided Activity 3

Practice using the file manager on your computer by following the instructions below:

1. Click on the Start menu button in the bottom-left corner of the screen.
2. Once the Start menu appears, enter in the term “explorer”. You should see a File explorer option appear in the Start menu.
3. Click on the File explorer option, which will open the file explorer on the PC.
4. Once opened, click on the This PC option on the left side. Here, it will display you the major directories. From here, you may explore the computer’s organizational system by searching through the folder hierarchy.

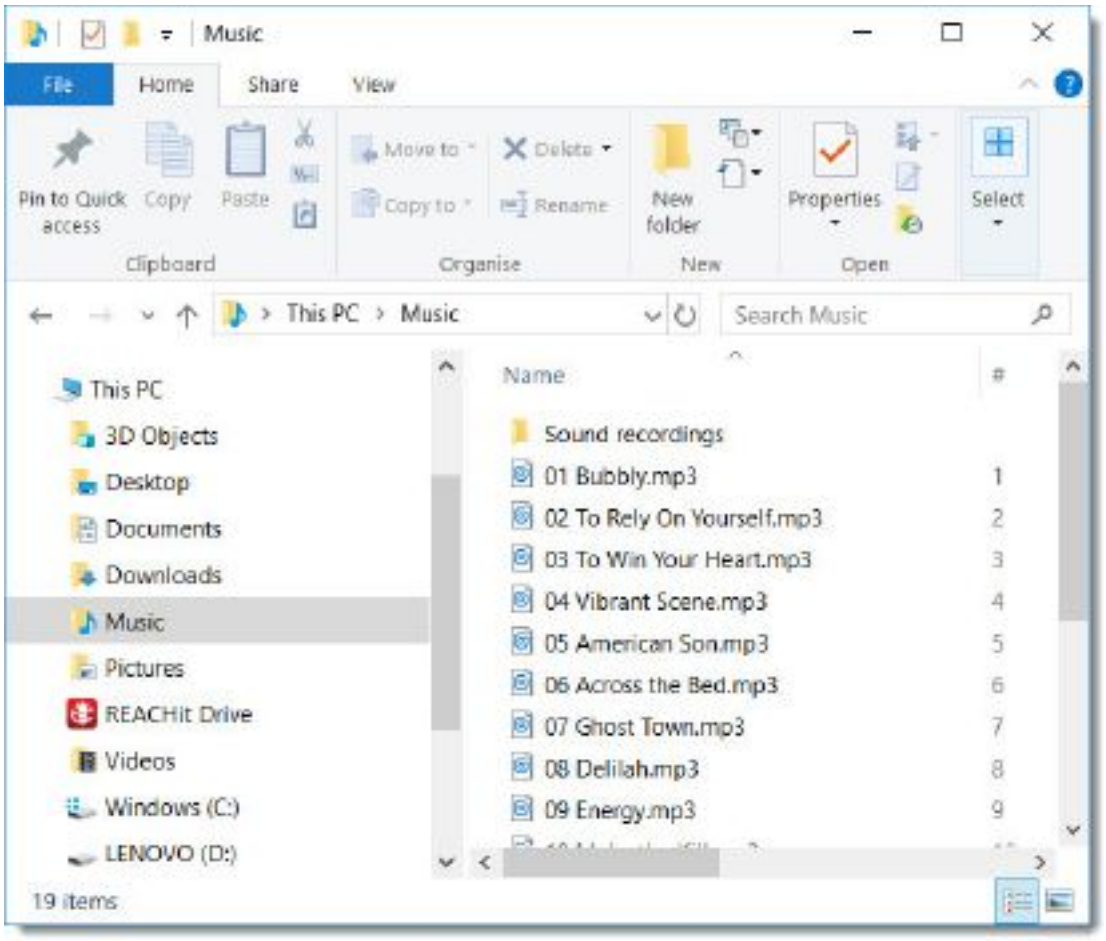


Checking how the computer is now arranged

In the This PC screen, the storage devices are shown by gray and black symbols and have the drive letter in their name. The graphic demonstrates that there are four storage devices, i.e., computer (C), data (D), USB drive (F), and recovery (E). By double-clicking on any of these storage devices, it will open, and you may view the files and folders contained in it. If you wish to open any files or folders, you should double-click on them.

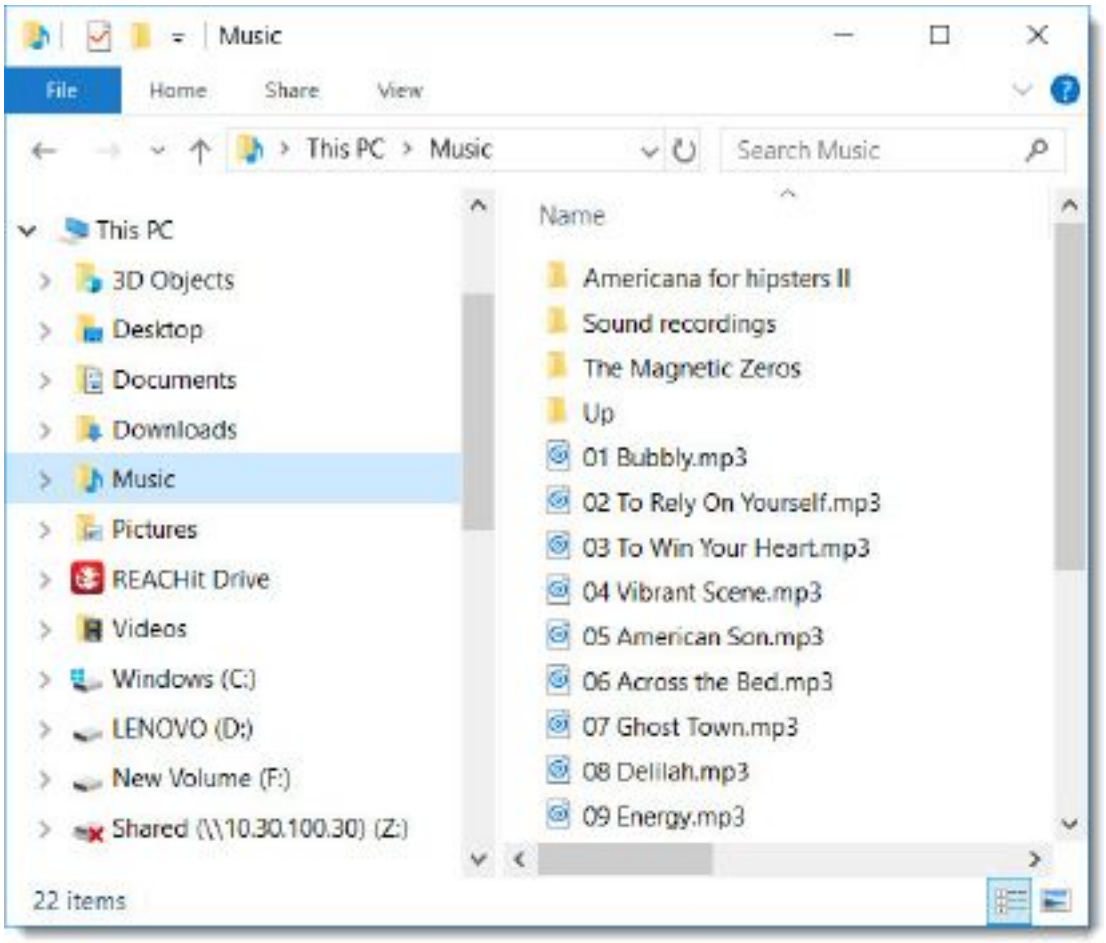
After you have reviewed the numerous files and folders on the computer, you can start arranging them.

As you have taught, files are saved on a computer within directories (called folders in Microsoft Windows). These folders are used to help arrange a computer's contents so that files may be located more readily. Each folder may contain any number of files or sub-folders. For example, a music listener may establish a Music folder with all her music files in it.



A folder holding a variety of music files

A highly structured music listener would have a music folder as the primary folder and then sub-folders for each artist. It may even have a sub-folder for each kind of music and then have files inside of that for each musician. This would make it much easy to discover tracks by a given artist.



Folders may hold both files and folders

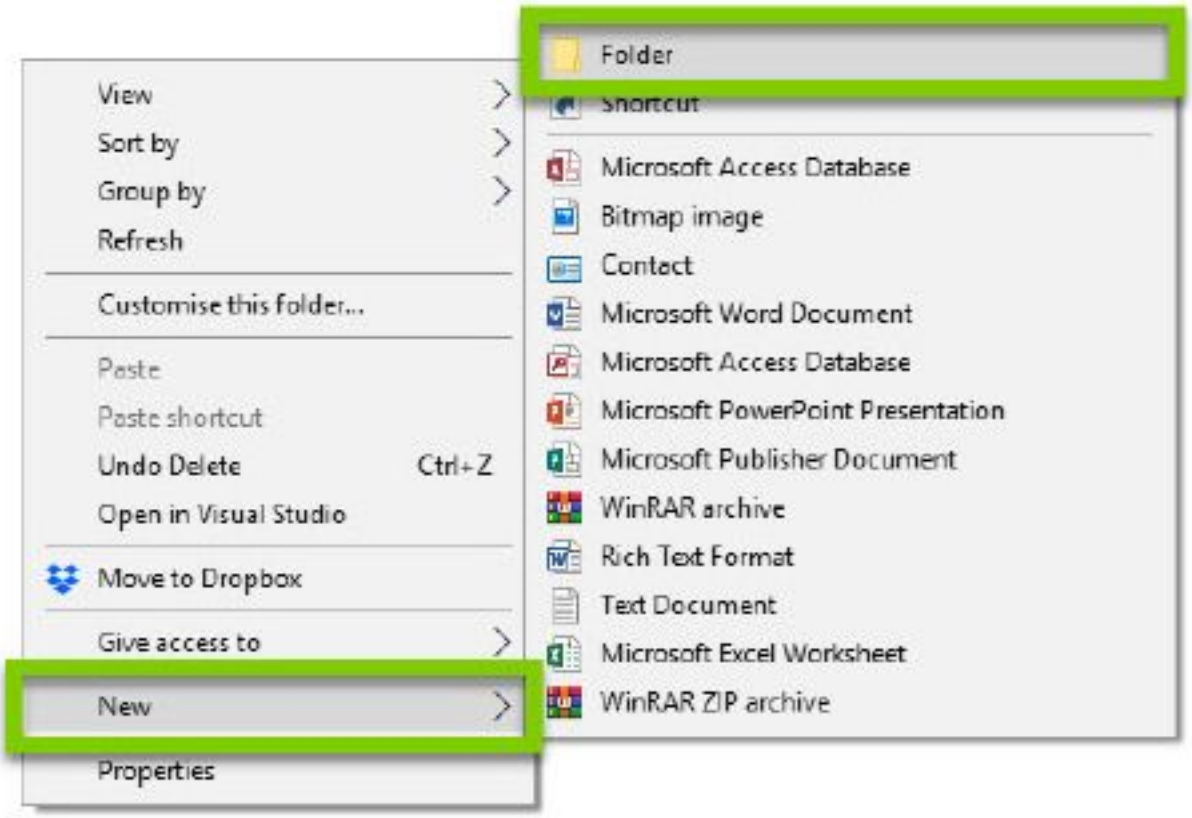
2.4 Creating and Naming Folders and Files

An essential component of establishing an efficient file structure is creating folders and sub-folders to manage your data.

Guided Activity 4

To create a new folder:

1. Using the File explorer, navigate to the spot where you wish to create a folder.
2. Open the Action menu by either right-clicking or by using the ALT-F shortcut key.
3. Hold the mouse cursor over the New option and pick the Folder option.
4. Enter a name for the new folder and click Enter on the keyboard.



Creating a new folder

The same process may be used to generate new files. However, instead of choosing the Folder option, the file type you wish to generate should be chosen.

To create a new file:

5. Using the File Explorer, navigate to the folder where you want to create a file, for example, Documents.
6. Right-click on an empty portion of the folder.
7. Click on New, then pick the kind of file that you wish to create.
8. Enter a new name for the file.
9. Press Enter.

File Naming, Conventions and Properties

File Naming and Conventions

A file name is used to identify a file on the computer. This is the finest approach of managing files and folders on the computer. Naming files appropriately enables you to explore and identify files and directories effortlessly.

A file-naming convention (FNC) helps maintain the computer clutter-free and enables you to accomplish the following:

- Know the contents of a file before you open it
- Navigate through extensive lists of files for the one that you are searching for
- Store several versions of the same document by labeling them according to date

Best practices for naming files:

- Keep file names brief yet relevant.
- Include relevant information, such as the name of the project or document on which you are working.
- Include the version number (e.g., v1 or -v1) and the date if there is more than one more version. Dates should always appear as yyyy/mm/dd to keep the files in order.

Things to avoid when naming files:

- Symbol characters, such as "\ / < > | " ? [ ] ; = + & $ α β"
- Abbreviations that are not simple to grasp
- Simple terms, such as "draft", "current" or "document".

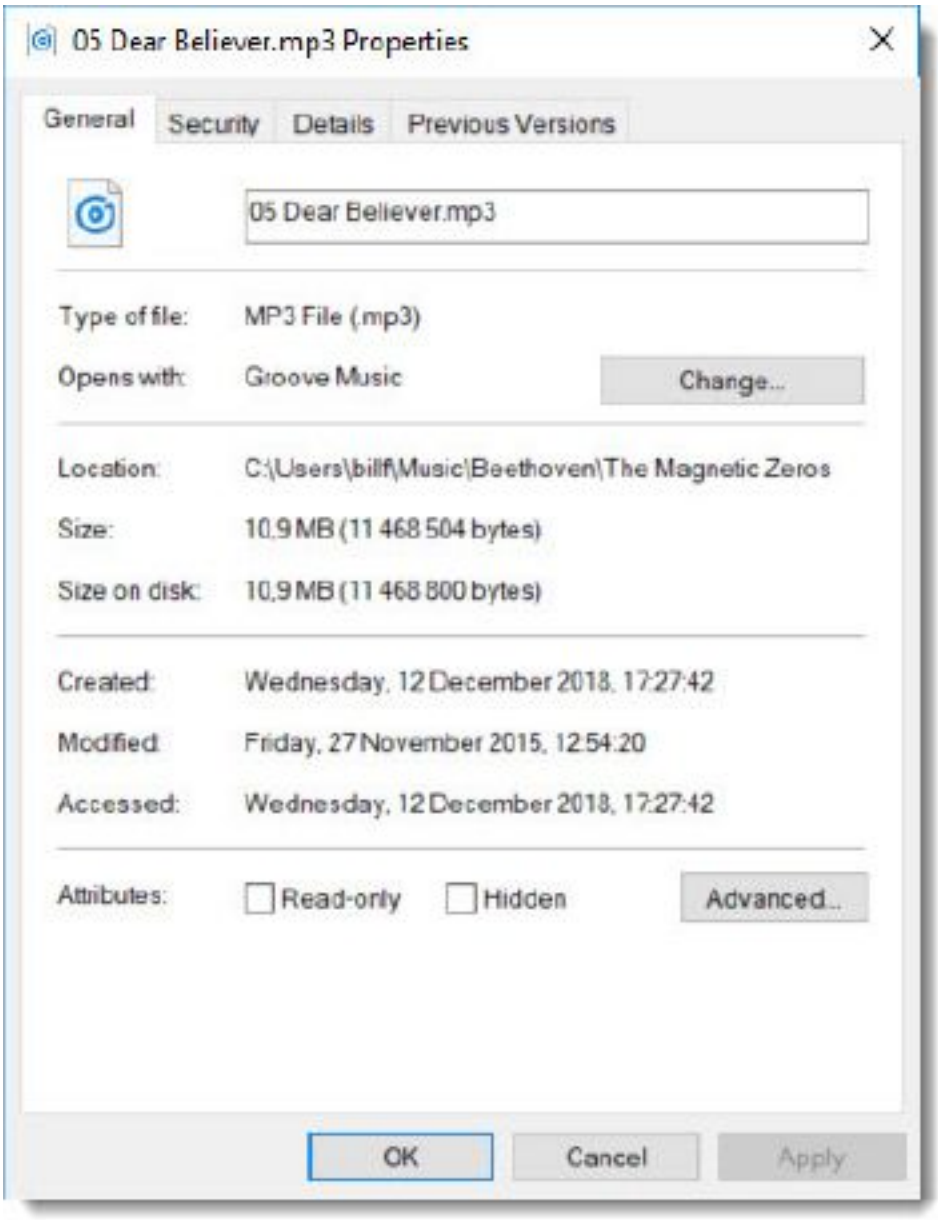
File Properties

The File properties box displays you a variety of information about a file, such as its file type, size, author, title and when it was modified last. The Properties pane will also provide you information on how you may alter the file.

Guided Activity 5

To examine the properties of a file, right-click on the file name and then click on Properties.

1. The Properties dialogue box will offer you information about the file, as you can see in the image below.



Properties dialogue box

Renaming Files

The Rename command allows you to change the name of files. As with Cut and Copy, there are three different ways to rename files.

ACTION MENU	SHORTCUT KEY	LEFT CLICK
1. Select the files you want to rename. 2. Right click on one of the selected files. 3. From the *Action* menu, select the *Rename* option. 4. Enter a new name for the file and press the *Enter* key.	1. Select the file you want to rename. 2. Press the *F2* key on the keyboard. 3. Enter a new name for the file and press the *Enter* key.	1. Select the file you want to rename. 2. Using the mouse, click on the name of the selected file. 3. Enter a new name for the file and press the *Enter* key.

How to rename files

When naming files, it is important that you name the files clearly and in an orderly way. The following are pointers to help you rename files and folders in an organised way:

- Avoid using a structure that is too difficult to follow.
- Since files are organised alphabetically, you need to think about the way in which you name files.
- Make sure that you can identify similar files based on the file names.
- Use the dash symbol to separate different items in a file name (for example, the name and date).

Copying Files

When you copy a file, a duplicate of the file is created and stored on the computer's clipboard. This duplicate file can then be copied onto any storage medium connected to the computer, using the Paste command.

There are three ways that you can copy and paste files.

ACTION MENU	SHORTCUT KEY	DRAG AND DROP
1. Select the files you want to copy. 2. Right click on one of the selected files. 3. From the drop-down *Action* menu, select *Copy*. 4. Navigate to the folder where you want to place the copied file. 5. Right click on the folder and select the *Paste* option from the *Action* menu.	1. Select the file you want to copy. 2. Press *Ctrl+C* on the keyboard. 3. Navigate to the folder where you want to place the copied files. 4. Press *Ctrl+V* on the keyboard to paste the files.	1. Select the files you want to copy. 2. In a different *File explorer* window, navigate to the folder where you want to place the copied files. 3. While pressing the *Ctrl* key on the keyboard, drag the files from the source folder to the destination folder. 4. Drop the files once they are over the destination folder.

How to copy and paste files

Moving Files

When moving files, the file or files that you move are copied to a new destination, but then deleted from its original destination. When doing this, you have not created a copy file, but you have moved a file from one folder to another folder.

To move files, you need to cut and paste them, and NOT copy and paste them.

ACTION MENU	SHORTCUT KEY	DRAG AND DROP
1. Select the files you want to copy. 2. Right click on one of the selected files. 3. From the *Action* menu, select the *Cut* option. 4. Choose the folder where you want to place the copied files. 5. Right click on the folder and select the *Paste* option from the *Action* menu.	1. Select the file you want to copy. 2. Press *Ctrl+X* on the keyboard. 3. Navigate to the folder where you want to place the copied files. 4. Press *Ctrl+V* on the keyboard to paste the files.	1. Select the file you want to copy. 2. In a different *File explorer* window, navigate to the folder where you want to place the copied files. 3. While pressing the *Shift* key on the keyboard, drag the files from the source folder to the destination folder. 4. Drop the files once they are over the destination folder.

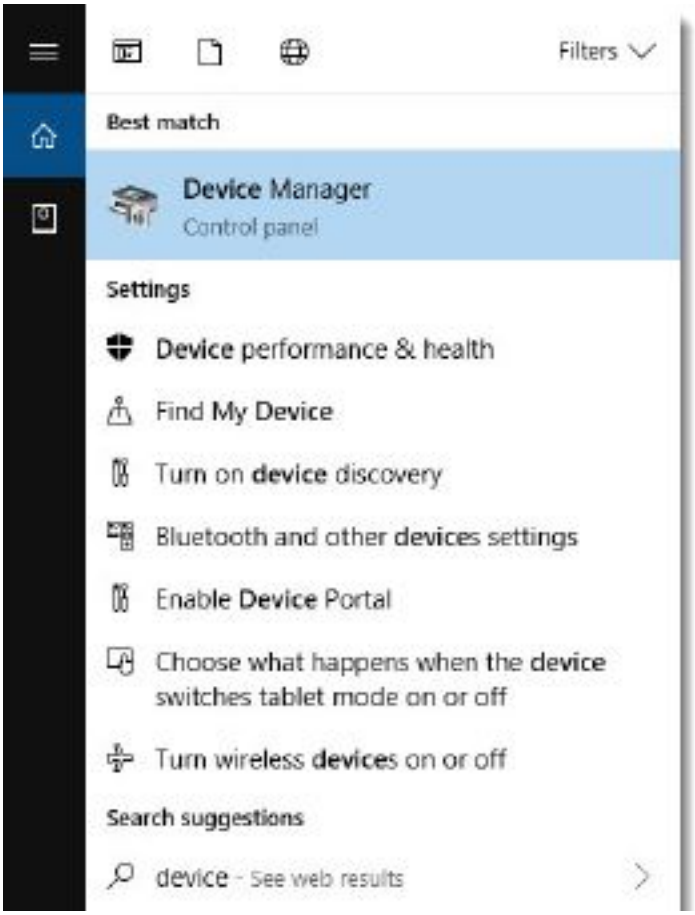
How to move files

Searching for Files

If you are struggling to find a file on the computer, you can always search for it. The search function allows you to look for any file that is on the computer.

To search for a file in Windows 10, you can do the following:

1. Next to the Start button, you can type to search for the file you are looking for.



Searching for files

2. In the example above, the user typed in the word "device". You can see the search results above the search box.

When searching for files,

- Use different search terms: For example, if you are looking for a spreadsheet file, try using a different file name. You could have changed the file name while saving the file.

- Last application: If you used a specific application to open and edit the file, you can click on File > Open > Recent. The file you are looking for might appear in the list of files that you edited recently.
- Move and rename the file: After you have found the file, you can give it a new file name. Then, move it to a folder so that you can find it more easily at a later stage. For example, if it is a new song that you downloaded, move it to the Music folder.

Deleting Files

The Delete command enables you to remove files from the storage device. This command can be used to either remove files that you do not need anymore, or to make more space on the storage device.

In Microsoft Windows, deleted files are moved to the Recycle Bin. The Recycle Bin is a temporary folder where deleted files are stored until you remove them from the bin. Any files you delete will first be moved to the Recycle Bin before they are permanently deleted.

The following tables show how you can delete files from the computer and how these files can be deleted from the Recycle Bin.

ACTION MENU	SHORTCUT KEY
1. Select the files you want to remove. 2. Right click on one of the selected files. 3. From the *Action* menu, select the *Delete* option. 4. Click on the *Yes* button to remove the files.	1. Select the files you want to remove. 2. Press the *Delete* key on the keyboard. 3. Click on the *Yes* button to remove the files.

How to use the Recycle Bin

How to remove files from the computer permanently

EMPTY THE RECYCLING BIN	SHORTCUT KEY
1. Remove the files from the computer, as shown in the previous steps. 2. Go to the computer's desktop. 3. Right click on the *Recycle Bin* icon and select the *Empty Recycle Bin* option. 4. Click on the *Yes* button to remove the files.	1. Select the files you want to remove. 2. Hold *Shift* and press *Delete* on the keyboard. 3. Click on the *Yes* button to permanently remove the files.

Restoring Files

If you cannot find a file on the computer, or you have deleted it by mistake, you can still recover the file by restoring it from the Recycle Bin to its previous version.

Guided Activity 6

To restore files from the Recycle Bin, the following should be done:

1. Open the Recycle Bin by double-clicking on the icon that is usually found on the desktop.
2. Browse through the folder and select the file(s) or folder(s) that you need to restore.
3. Right click on the file or folder and from the Action menu, choose Restore.
4. The Recycle Bin will then restore the deleted file(s) or folder(s) to their original location.

2.5 File Types

Each file has a file extension identifying the type of file and how the computer should interpret it. A .txt file is a simple text document that contains words with no formatting. A .doc file allows for formatted text with different fonts and images.

This section will look at the following file types:

- Text files
- Document files
- Locked document files
- Web pages
- Archives and compressed files
- Presentation files
- Spreadsheet files
- Database files
- Image files
- Animation files
- Video files
- Audio files
- Adobe Acrobat

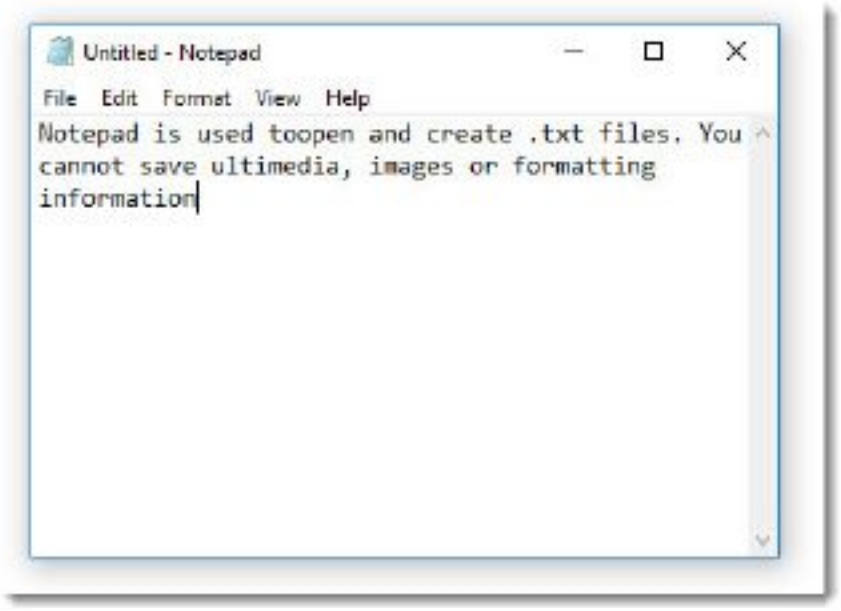
Text Files

There are two types of text files:

- .txt (text)

- .rtf (rich-text format)

Text files are files used to store plain text. Plain text refers to text that has no special formatting, such as fonts, font sizes, images and so on. In Microsoft Windows, text files are identified with the .txt file extension. Notepad is a popular application in Microsoft Windows that is used for opening and creating text files. Figure shows an example of a .txt file:

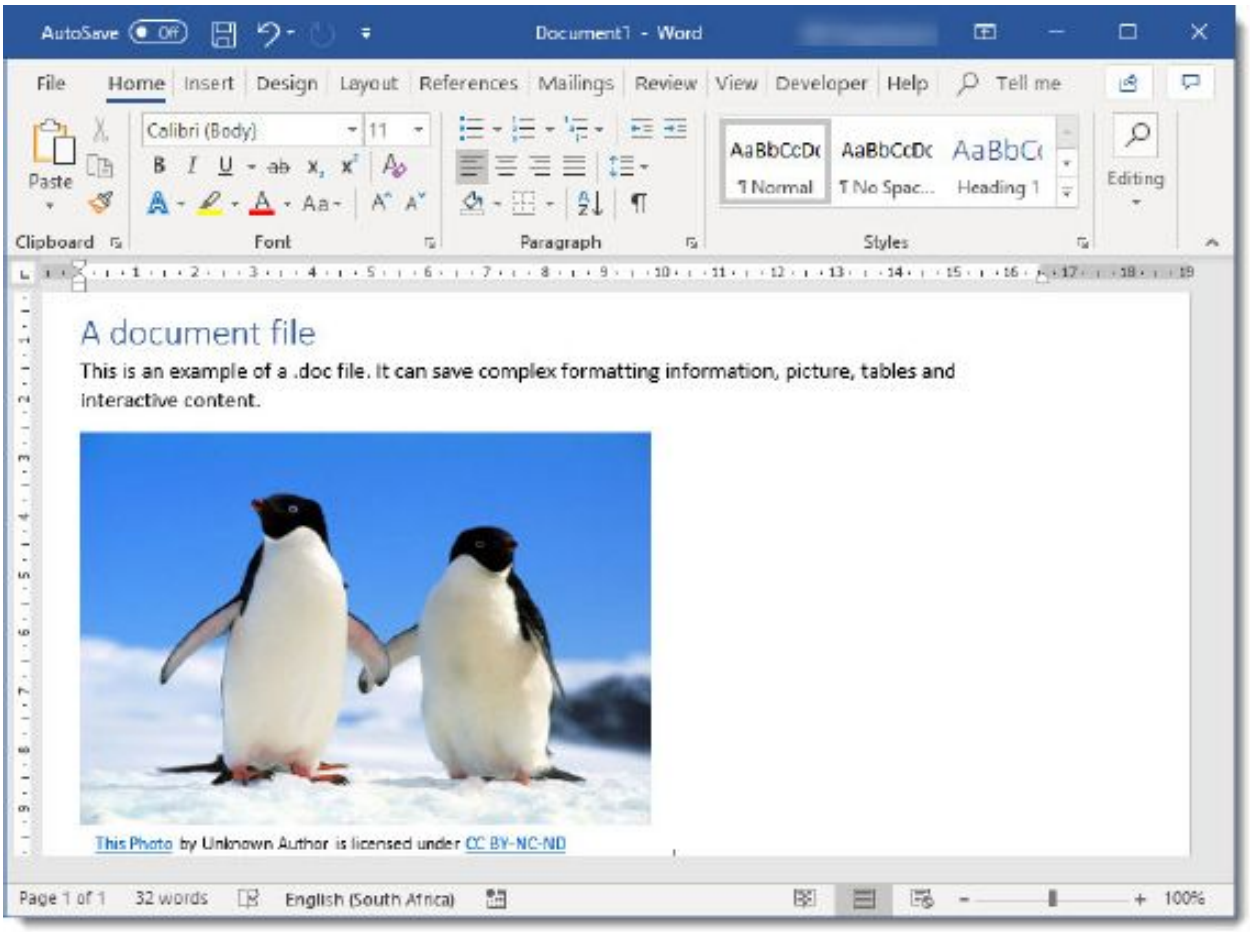

Untitled - Notepad
File Edit Format View Help
Notepad is used toopen and create .txt files. You cannot save ultimedia, images or formatting information

An example of a .txt file

Rich-text format (RTF) files can save more information than text files. This includes different font types, such as BOLD, italic, as well as font colour. RTF files cannot be opened in Microsoft Notepad, but can be opened in Microsoft WordPad. Both these applications are installed with Microsoft Windows for free.

Document Files

Although document files (.doc, .docx and .odt) are used to store documents. It differs from text files and rich-text files because it can store more complex information such as custom formatting options and styles. Word processors for example, Microsoft Word, Google Docs and LibreOffice can be used to create and edit document files.



Document files can store text with advanced formatting

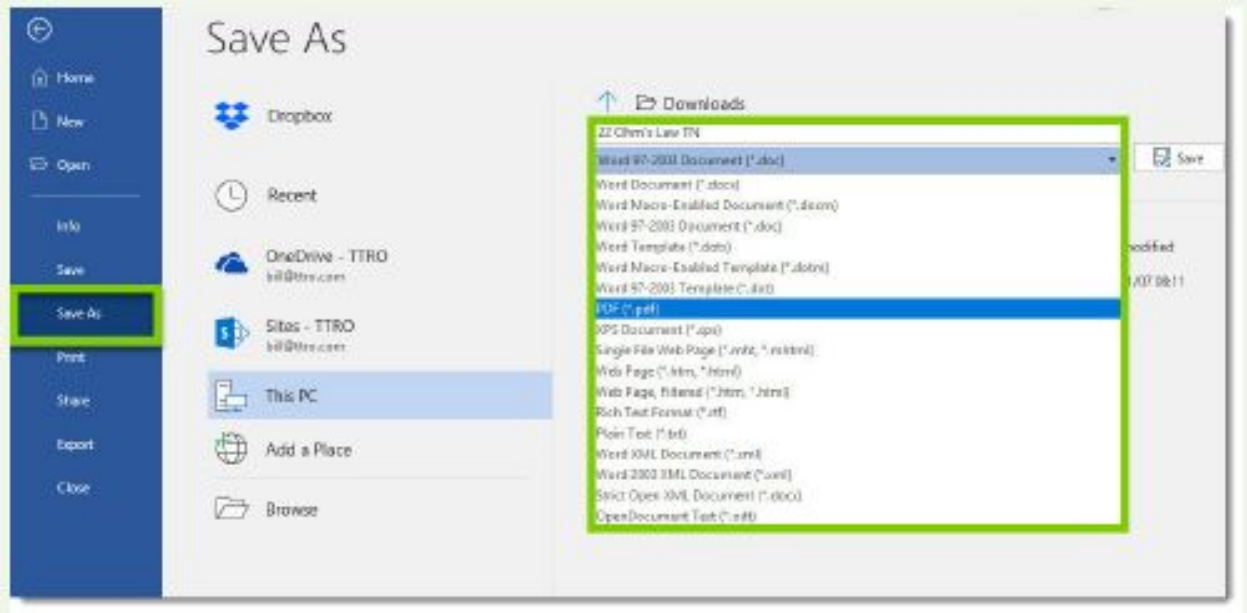
Different Types of Text Files

Jabulani is a Grade 12 learner who works almost every day on his computer on various school assignments. He recently learned that, although two different files may look the same when not formatted, for example a .txt file and a .doc file, the data actually differs. This means that he cannot just change the file type of one file to another and expect the document to open.

However, computer applications have improved quite significantly in that applications, such as Microsoft Word or LibreOffice, can convert one file type to another.

Example 1

To save the file in a different file format using the Save As function, Jabulani does the following: By clicking on the Save As button, a dialogue box opens. This allows him to select the type of file he wants to save his file as, for example PDF, plain text, web page and so on. The application then makes sure that the raw data is saved in the correct way for that file format. An example of this dialogue box is shown in Figure on the next page.



Save As allows you to select the file type you want to use

Locked Document Files

Locked documents are documents with content that is difficult to change, or modify once it has been created. Locked documents are generally used in situations where you want to use the file in the format in which it was saved. Examples of locked document files would be contracts, formal letters and shop catalogues. The two most common locked document formats are the .pdf (portable document format) and .epub (E-PUB) file formats.

Web Pages

A web page is a computer file that relates to websites and web servers. Web pages include information, such as the colours of text, backgrounds and images. It also includes links to images and other types of multimedia.

The two most common extensions for web pages are:

1. .html
2. .htm

The only difference between the two is that .htm is used as an alternate to .html by a few web servers that do not accept four-character extensions. Both extensions can be used on most web servers.

Archives and Compressed Files

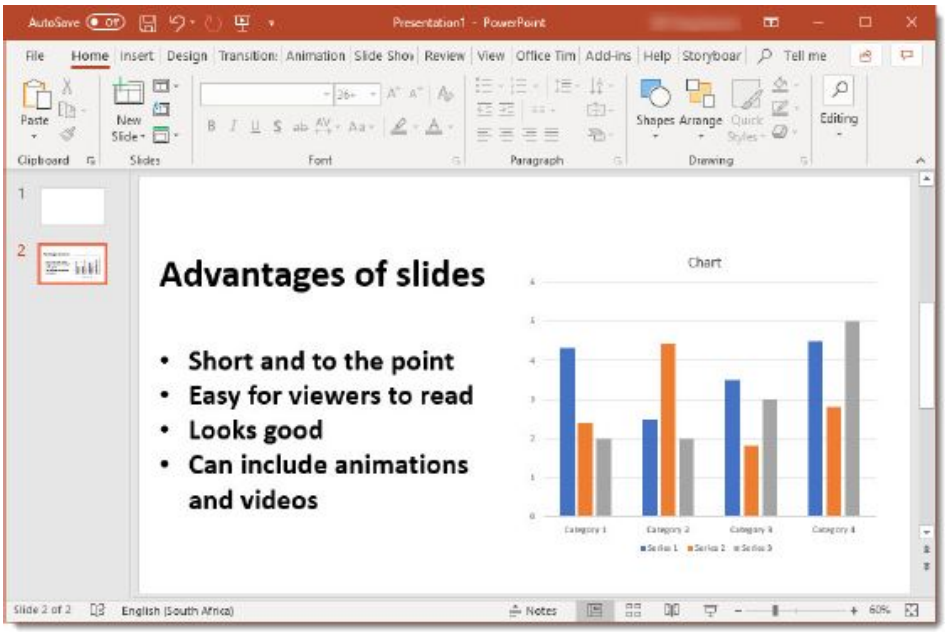
Archives are types of files that can combine and compress multiple different files into one file. For example, if you need to send 50 files in an email to a group member, it will be much easier for you to combine and compress the files into a single .zip file, before sending the .zip file through email. This will make it so much easier for the other person to download the file. The .zip file will also be smaller since all the files are compressed into one file, making it easier to send and download. After receiving the files, it can be decompressed and accessed normally. The three main file extensions for archives are:

1. .zip
2. .rar
3. .7z

Presentation Files

A presentation file stores information using slides that can be shown consecutively. Presentation files are used by teachers, businesses and learners where the speaker discusses the topic using the content of the slides. Slides are short, they can contain pictures and animations, and are generally attractive. The three main file extensions for presentations are:

1. .ppt
2. .pptx
3. .odp



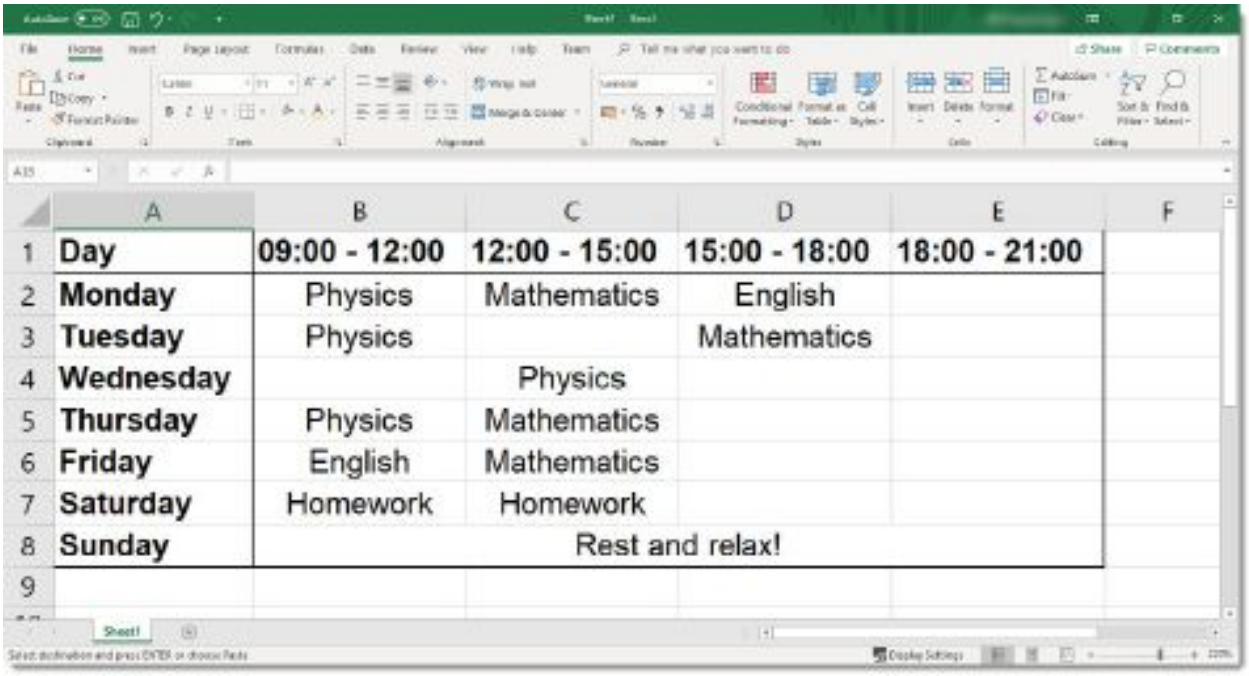
A slide in a presentation

Spreadsheet Files

A spreadsheet file is a file that stores information in a large table. Companies use spreadsheets when they need to analyse large amounts of data, or do calculations. It is also used to show data, such as checklists and class lists. The three main file extensions for spreadsheets are:

1. .xls
2. .xlsx
3. .ods

The spreadsheet file gets its .xls (and .xlsx) extension from the most popular spreadsheet software i.e. Microsoft Excel. Figure 3.18 is an example of someone's academic schedule.

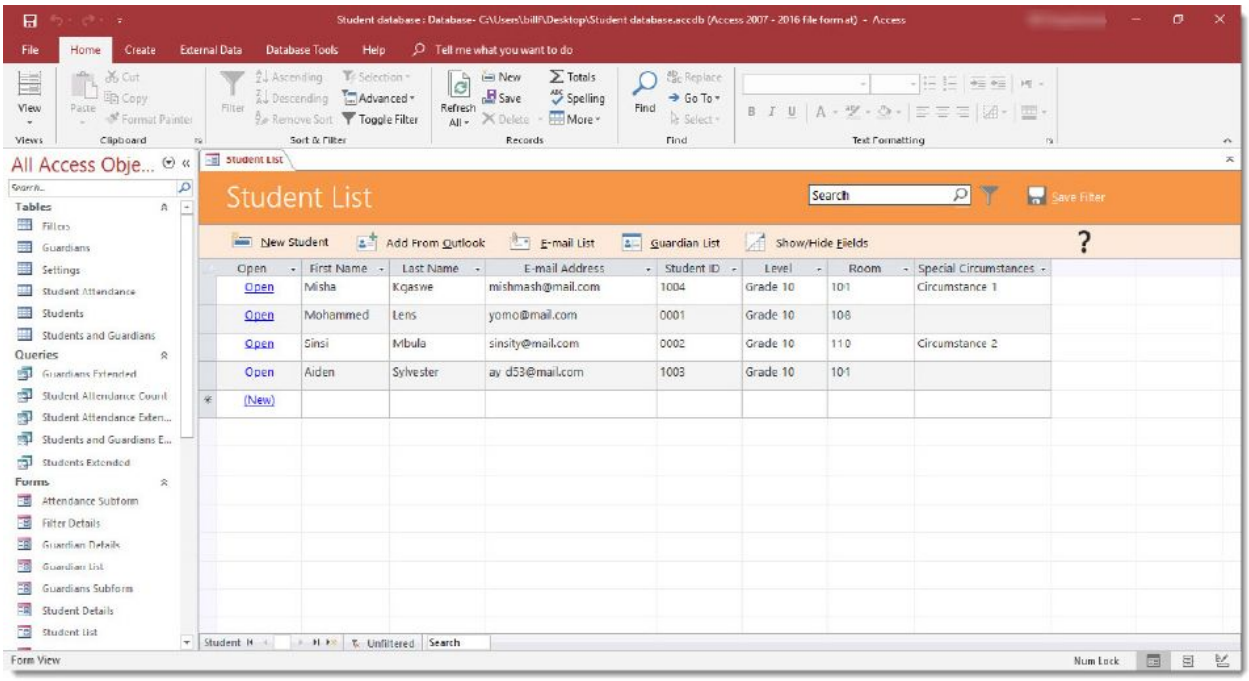


	A	B	C	D	E	F
1	**Day**	**09:00 - 12:00**	**12:00 - 15:00**	**15:00 - 18:00**	**18:00 - 21:00**	
2	**Monday**	Physics	Mathematics	English		
3	**Tuesday**	Physics		Mathematics		
4	**Wednesday**		Physics			
5	**Thursday**	Physics	Mathematics			
6	**Friday**	English	Mathematics			
7	**Saturday**	Homework	Homework			
8	**Sunday**	Rest and relax!				
9						

Spreadsheets show data in tables

Database Files

Databases are similar to spreadsheets, except that the sheets, called tables, are all connected to each other. For example, your school might have a database for each grade with the full names of the learners, names of their parents, their contact details, addresses and the amount of school fees paid. Even though these items are listed in different tables, they are still linked together. Because of this, at the end of the month when the school needs to send out fee statements, the database software can create a statement where your name and surname, parents' contact details and fees owed are all displayed on the same page.



Databases can store related information in different tables

Most programmers use databases to store important data for their software.

Image Files

There are five main formats used to store graphics:

1. .bmp (bitmap image)
2. .gif (Graphics Interchange Format)
3. .jpg or .jpeg (Joint Photographic Experts Group)
4. .png (portable network graphics)
5. .tiff (tagged image file format)

These image formats are used for cameras, scanning and printing. Most of these file formats need not be compressed and are, therefore, ideal for printing and web graphics. Photos taken by a camera, or pictures created using software, for example, Microsoft Paint or Adobe Photoshop, are often saved in one of these formats.

Animation Files

Animation files are files that interpret moving images. The two most common animation file formats are:

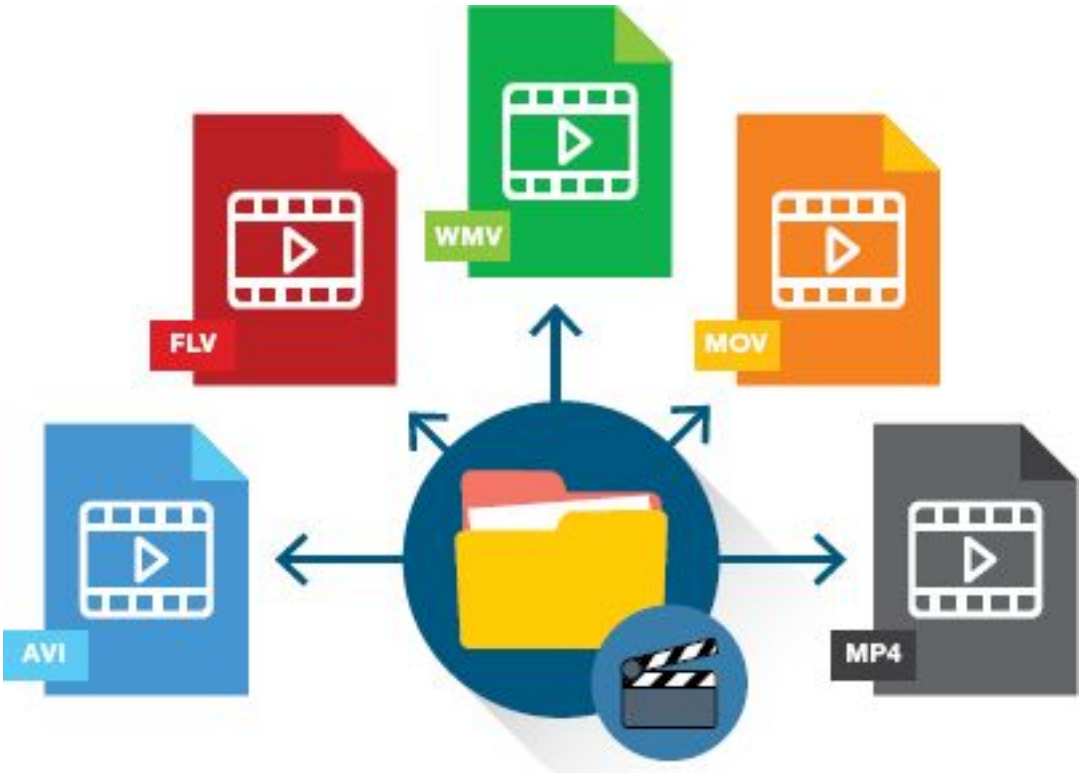
1. .gif
2. .swf (Small Web Format Flash)

Although both these formats create animations, they do so in two different ways. GIF animations show normal GIF images one after another to create an animation; SWF files use programming to move shapes on the screen, creating an animation.

Video Files

A video file format is used to store digital video data on a computer. Video file formats are usually compressed to reduce the file size. Video files are made up of a "container" and a "codec". A codec is used to compress and decompress the video where the video files are too big, causing the video not to play, or be downloaded. Examples of codecs include FFMpeg, DivX, XviD and x264.

A container is a set of files that stores information about the digital file. For example, a container in a video file would be a combination of both audio and video in a single file so that the file can play both audio and video at the same time. Some common types of containers would be AVI, FLV, WMV and MP4.



Different types of video file formats

Sound Files

Sound (audio) files are similar to video files, as they are compressed before they are stored on a computer. They are used to store audio files, such as music. Because of the popularity of using

computers to store music and videos, the .mpeg and .mp3 file types have become very popular in recent years. Common audio file formats consist of the following:

- .aac (Advanced Audio Coding)
- .flac (Free Lossless Audio Codec)
- .mp3 (Moving Picture Experts Group Layer 3 audio)
- .wma (Microsoft Windows Media Audio).

Portable Document Format (PDF)

Adobe Acrobat is an application developed by Adobe Systems where you can view, create, print and manage files in a portable document format (PDF). PDFs are a very good file format for saving books, or published documents that can be easily sent to another user through email, etc.

Converting a Document to a PDF

You can convert a document to a PDF by doing the following:

1. Click on the file that you want to be converted into PDF format.
2. Click on the File tab and choose Save As.
3. Type in the file name.
4. Using the drop-down menu, click on the PDF under the Save As type.
5. Click Save and the document will be saved in a PDF format.

2.6 Summary

This section focuses on the ideas and methods of successful file management in computer systems. It covers numerous file kinds, storage technologies, and organizing ways to maximize efficiency and accessibility.

2.7 Assessment Questions

1. Explain the significance of having consistent naming standards for files.
2. What are the advantages of using folders to organize files?
3. Describe two approaches for retrieving lost or deleted data.
4. Discuss the role of metadata in file management. How does it assist the organizing and retrieval of files?
5. Analyze the hazards associated with improper file management techniques. Provide instances of possible effects.

6. Evaluate the value of data security in file management. What techniques may be used to secure sensitive information?

Module 3: Introduction to Basic Programming

Unit 3: Introduction to Multimedia System

Flow of the Unit

3.0 Objective
3.1 Introduction
3.2 Elements of Multimedia System
3.3 Characteristics of Multimedia System
3.4 Significant Features of Multimedia Computer System
3.5 Uses of Multimedia Presentation
3.6 Advantages of multimedia
3.7 Disadvantages of multimedia
3.8 Applications of Multimedia
3.9 Summary
3.10 Assessment Question
3.11 Reference

3.0 Objective

a. Explain the brought concept multimedia.
b. Explain elements of multimedia system.
c. Distinguish between a file and a folder.
d. Explain the importance, characteristics and features of using the multimedia system.
e. Describe the different types of application of social media.

3.1 Introduction

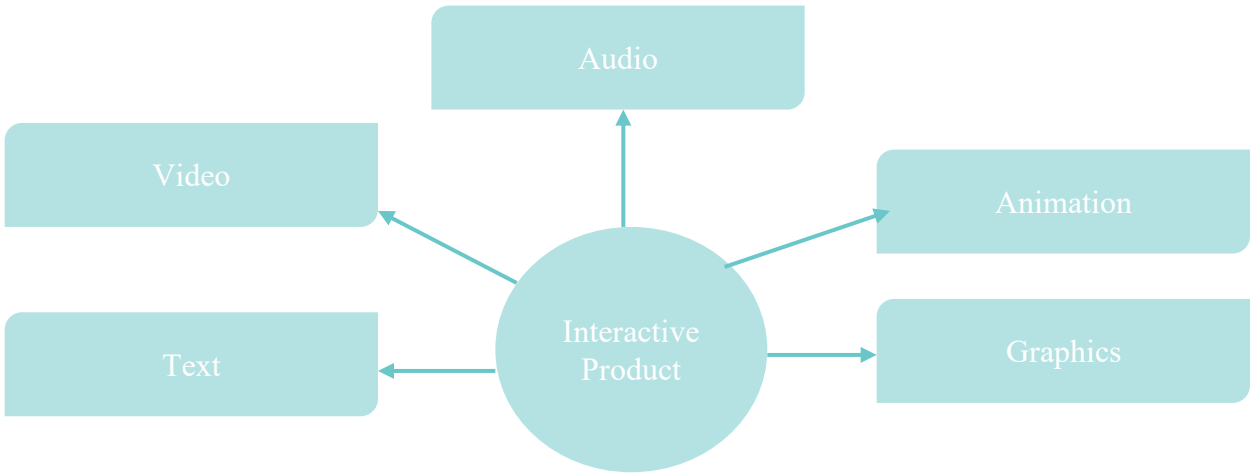
Multimedia has become an integral aspect of every presentation. It has found a multitude of uses, spanning from entertainment to teaching. The growth of the internet has also raised the need for multimedia information.

Derived the definition of "multimedia"

- Multi − it denotes more than one or numerous or many.
- Medium − it denotes intermediate or medium
- Media − it implies delivering the information. Means dissemination tools & information presentation- text, audio, video, picture, voice, graphic & others.

Definition

- Multimedia is a Software Technology that integrates multiple media like Sound, Video, Images and Text either independently or in Combination utilizing Computer.
- Multimedia indicates that Computer information may be conveyed using Audio, Video and Animation in Addition to Traditional Media (Text, Graphics, Drawings, and Images).
- Multimedia is a Computer Based Interactive Communications Process.
- Multimedia is the medium that employs several types of information content and information processing (e.g., text, voice, graphics, animation, video, interaction) to inform or amuse the user. Multimedia also refers to the use of electronic media to store and consume multimedia material. Multimedia is akin to conventional mixed media in fine art, but with a greater reach. The word "rich media" is synonymous with interactive multimedia.



Multimedia

3.2 Elements of Multimedia System

There are five aspects of multimedia:

1. Text
2. Audio
3. Video
4. Graphics
5. Animation

1. TEXT

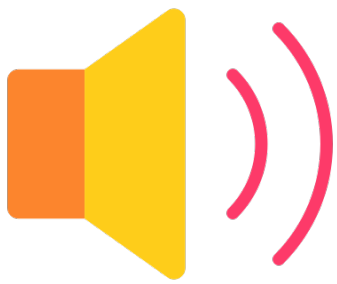
- Characters that are used to make words, phrases, and paragraphs.
- Text may often be forgotten, yet it is still the most essential ingredient and most efficient means to communicate in multimedia.

Arial	Tahoma
Times New Roman	Helvetica
Stylus	ONYX
Gothic	Ravie
Courier	Nyala
Script	broadway
	CASTELLAR

Text: PC Fonts

2. Audio

- Itismusic,speech,oranyothersound.
- Sound can boost your website design and social media platforms.
- It is a multimedia program that employs conversation, recorded narration, music, and sound effects.
- These are termed the audio or sound components.



Audio

3. Video

- Photographic pictures that are played back at rates of 15 to 30 frames a second and offer the illusion of full motion.
- Video is a visual multimedia program that mixes a succession of photos to produce moving visuals and sound.

Video

4. Graphics

A computer representation of non-text information, such as a sketch, chart, or photograph.

Graphics are an important part of multimedia because humans are visually oriented.

Images include images, illustrations, sketches, clip art, icons or any other non-text components on a website or in social media are an example of graphics.

Graphics: Graphic Design Tools

5. Animation

- Flipping through a succession of static photos. It is a succession of visuals that give an appearance of motion.
- Animated components are ubiquitous multimedia applications.
- Animation is a succession of pictures strung together to produce the appearance of movement.

Animations: Movies and Cartoon

Multimedia indicates that computer information may be represented using audio, graphics, pictures, video, and animation in addition to conventional media (text and graphics). Hypermedia may be viewed as one form of unique multimedia application.

Categories of Multimedia Multimedia may be roughly split into linear and non-linear categories. Linear active material proceeds without any navigation control for the spectator, such as a movie presentation. Non-linear material enables user engagement to control progress, as utilized with a computer game or in self-paced computer-based instruction. Non-linear material is also known as hypermedia content.

Multimedia presentations may be live or recorded. A recorded presentation may provide interaction via a navigation system. A live multimedia show may provide interactivity via interaction with the presenter or performer.

3.3 Characteristics of Multimedia System

- We all know about that. Multimedia refers to the material that employs more than one medium. Multimedia is the mixture of
  a. TEXT
  b. SOUND
  c. GRAPHICS
  d. IMAGES
  e. ANIMATION
  f. VIDEOS
- The Important Characteristics of a Multimedia System are:
  a. **MULTIPLE MEDIA CONTROLLING :** Multimedia must be computer-based controlled.
  b. **INTEGRITY:** Multimedia System are Integrated.
  c. **DIGITAL REPRESENTATION:** The Information handle must be Represented Digitally.
  d. **SCOPE OF INTERACTIVITY:** The interface to the final display of media is frequently interactive.

3.4 Significant Features of Multimedia Computer System

1. Its Central Processing Unit (CPU) is incredibly fast, since it has to handle enormous quantity of data.
2. It has enormous storage capacity.
3. It has huge memory power that assists in executing massive data applications. It features a high-capacity graphic card that assists in showing graphics, animation, video, etc. Thesoundsystemmakesiteasytolistentoaudio.

3.5 Uses of Multimedia Presentation

1. E-books
2. DigitalLibrary
3. E-learning
4. Movie making Video games Animatedfilms

5. Multimedia conferencing
6. E-shopping

3.6 Advantages of multimedia

1. It may be utilized to aid the student and instructor to teach as well as to understand the supplied subjects effortlessly.
2. It may be used to distribute information all across the globe at a reasonable cost.
3. Itcanbeusedforanysubjectsandforanyone.
4. Multimediasystemisgenerallyveryinteractive.So, it is engaging and straightforward to use.

3.7 Disadvantages of multimedia

1. Lost in cyberspace.
2. Lack of structure.
3. Non-interactive if one way, no feedback.
4. ComplextoCreate.
   Timeconsuming.

3.8 Applications of Multimedia

Multimedia finds its use in different sectors, including, but not limited to, ads, art, education, entertainment, engineering, medical, mathematics, business, scientific research, and spatial and temporal applications.

A few application areas of multimedia are given below:

Creative industries

Creative industries employ multimedia for a range of objectives ranging from fine arts to entertainment to commercial art to journalism to media and software services given for any of the businesses mentioned below. An individual multimedia designer may span the spectrum over their career. Requests for their expertise span from technical to analytical and to artistic.

Commercial

Much of the electronic old and new media employed by commercial artists is multimedia. Exciting presentations are used to gain and hold attention in advertising. Industrial, business-to-business, and interoffice communications are typically generated by creative services businesses for complex multimedia presentations beyond conventional slide shows to market ideas or liven-up

training. Commercial multimedia developers may be recruited to build for governmental services and nonprofit services apps as well.

Entertainment and Fine Arts

In addition, multimedia is actively employed in the entertainment business, notably to generate special effects in movies and cartoons. Multimedia games are a popular activity and are software applications accessible either as CD-ROMs or online. Some video games also incorporate multimedia aspects.

Multimedia apps that enable users to actively interact instead of merely sitting by as passive consumers of information are termed Interactive Multimedia.

Education

In Education, multimedia is used to develop computer-based training courses (popularly termed CBTs) and reference books like encyclopedia and almanacs. A CBT enables the user navigate through a sequence of presentations, text on a specific subject, and accompanying images in different information forms. Edutainment is an informal phrase used to describe integrating education with enjoyment, particularly multimedia entertainment.

Engineering

Software developers may employ multimedia in Computer Simulations for everything from entertainment to instruction such as military or industrial training. Multimedia for software interfaces are generally done as cooperation between creative people and software developers.

Industry

In the Industrial sector, multimedia is employed as a technique to assist display information to shareholders, supervisors and colleagues. Multimedia is also effective for offering staff training, promoting and selling items all over the globe via almost endless web-based technology.

Mathematical and Scientific Research

In Mathematical and Scientific Research, multimedia is mostly utilized for modeling and simulation. For example, a scientist may look at a molecular model of a certain chemical and change it to arrive at a different substance. Representative research may be found in publications such as the Journal of Multimedia.

Medicine

In Medicine, physicians may be taught by looking at a virtual operation or they can mimic how the human body is affected by illnesses caused by viruses and bacteria and then design strategies to avoid it.

Multimedia in Public Places

In hotels, train stations, retail malls, museums, and grocery shops, multimedia will become accessible at stand-alone terminals or kiosks to give information and assistance. Such systems decrease strain on conventional information booths and workers, provide value, and they may function around the clock, even in the middle of the night, when live assistance is off duty. A menu screen from a grocery kiosk that offers services ranging from meal planning to coupons. Hotel kiosks offer neighboring restaurants, maps of the city, flight timetables, and give guest amenities such as automatic checkout. Printers are typically installed so consumers may go away with a printed copy of the material. Museum kiosks are not only used to assist clients around the exhibitions, but when positioned at each exhibit, give considerable additional depth, enabling visitors to browse through highly detailed material particular to that show.

2.9 Summary

This unit introduces the idea of multimedia systems, which combine many types of media—text, audio, pictures, animation, and video—to generate interactive content. Key subjects discussed include:

Definition and Components: Understanding what makes multimedia and the fundamental components involved, including hardware (e.g., computers, projectors) and software (e.g., editing tools, players).

Types of Multimedia: Exploring diverse forms of multimedia, such as graphics, music, video, and animation, and its uses in many industries including education, entertainment, and advertising.

Multimedia Standards and Formats: Overview of popular multimedia file formats (e.g., MP3, JPEG, MP4) and the necessity of standards in assuring compatibility and quality.

Design Principles: Introduction to the fundamentals of multimedia design, including usability, accessibility, and user engagement.

Applications of Multimedia: Discussing real-world applications of multimedia systems in fields such as e-learning, gaming, digital marketing, and virtual reality.

By the conclusion of the lesson, students will have a solid grasp of how multimedia systems function and their relevance in current digital communication.

2.10 Assessment Questions

1. Define multimedia and cite two instances of its use.
2. Explain the relevance of usability in multimedia design.
3. What are some frequent problems experienced in multimedia content creation?
4. Discuss the importance of multimedia in education. How does it increase the learning experience?
5. Analyze the influence of multimedia on digital marketing strategy. Provide examples of effective multimedia marketing.
6. Evaluate the ethical implications related with multimedia material, such as copyright and accessibility difficulties.

Module 3: Introduction to Basic Programming

Unit 4: Use of Internet for E-mail and Information Search

Flow of the Unit

4.0 Objective
4.1 Introduction
4.2 World Wide Web
4.3 Searching for Information
4.4 Creating an E-mail Account
4.5 Summary
4.6 Assessment Question
4.7 Reference

4.0 Objective

a. Define the internet in its global, network and wholesome contexts.

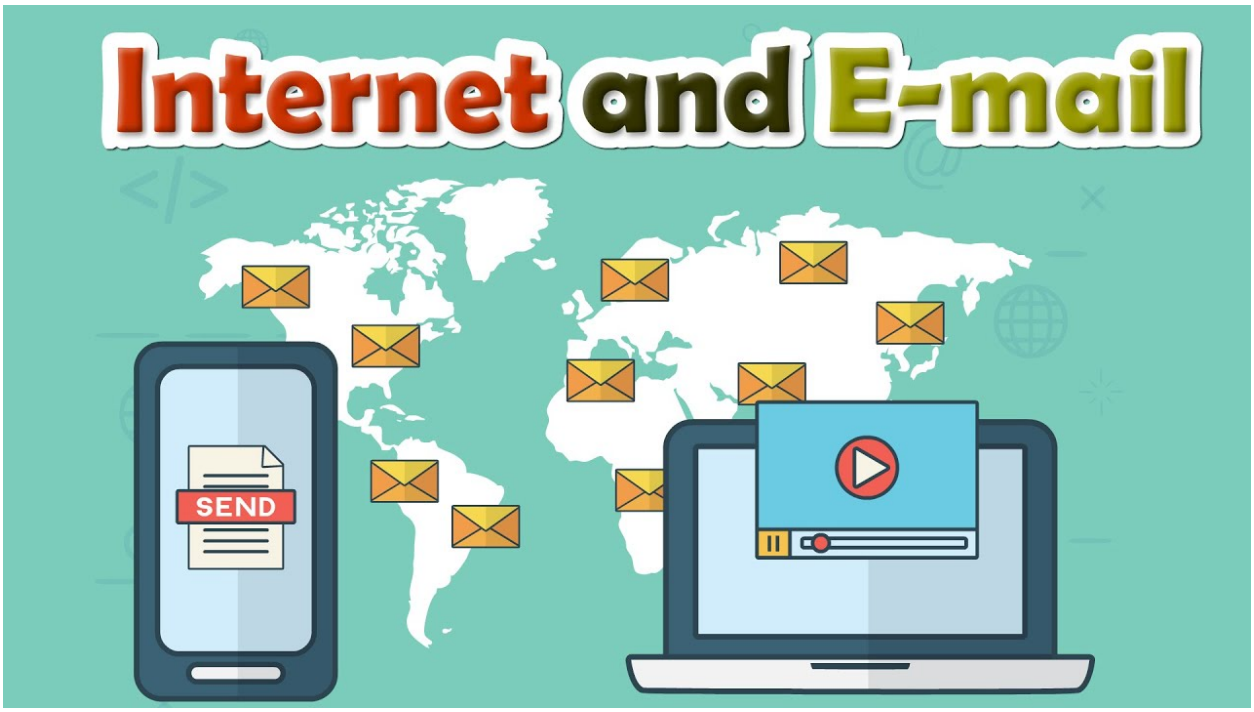
b. Distinguish between the internet and World Wide Web

c. Able to create, maintain and send an E-mail

4.1 Introduction

Internet is a worldwide system of interconnected computer networks. It connects several millions of computers all over the world. There is no central computer. All computers are placed at different places and are connected to each other by phone lines, cables or wireless connections. Any two computers connected to the internet can exchange information. The internet is therefore a very fast and efficient way of sending information. According to recent statistics, there is an estimated 3,179,035,200 internet users worldwide. The number of Internet users represents nearly 40 per cent of the world's population. The largest number of Internet users is in China, followed by the United States and India. This chapter is organized as follows. It gives an introduction to internet and its applications in day to day life followed by basic requirements for connecting to internet. Subsequently a brief on World Wide Web, Web browsers, search engines, online safety measures are given. Lastly, a step by step procedure for creating e-mail ID is given in the chapter. Internet has been the most beneficial technology of the modern times which supports us not only in our daily lives, but also our personal and professional lives developments. The internet helps to attain this in several ways. Emails, blogging, chatting are the modern ways of communication. All the information you want regarding anything is now just a click away. E-marketing, e-business, e-commerce and internet shopping are becoming popular really fast. To make sure your search for the required information is fast and smooth, search engines are created, that can open up a diverse

range of websites, loaded with information that you may need. The internet is therefore the largest encyclopedia for everyone, in all age categories. Movies, music, videos and games are all available for your entertainment. The top 5 most popular websites in the world are: Google, Facebook, YouTube, Yahoo, and Baidu (basically the Chinese version of Google).



Internet and E-mail

To connect to internet, computer/mobile, communication channel, modem, browser and Internet Service Provider are required. Computer is the most frequent device used to access the internet. A communication route, such as a telephone line, a cable or a wireless signal (WiFi) is needed to connect to internet. A modem, which is a hardware device that translates computer information into a suitable form, is required for transmission across the communication channel. It enables us to interact with other computers.

A program called browser helps to show the information and visuals contained in a website on your computer. Google chrome, internet explorer, Mozilla Firefox are some of the popular browsers. An Internet Service Provider (ISP) like as BSNL, Idea, Airtel is necessary to offer connections to households and offices.

4.2 World Wide Web

The fastest growing area of internet is World Wide Web (WWW). The web enables you to access information stored in computers connected to the internet. Web consists of millions of websites.

Most of these websites are divided into pages called web pages. There is one main page or starting page called as Home page. You can go to any other page in the site from the Home page. The links to other pages are called hyperlinks. They are not limited to pages in the sites you are in. Some hyperlinks on a page may take you to page on another site on another computer. Thus hyperlinks can take you on a worldwide tour of connected pages in different computers containing related information. Moving from one site to another on WWW is called surfing the Net. HTTP protocol (hypertext transfer protocol) is one of the ways to transmit data in the web. It also utilizes special software called browsers to access websites and their graphics, sounds and animations. Google Chrome, Internet Explorer and Mozilla Firefox are popular browsers.

Word Wide Web

4.3 Searching for Information

The internet provides easy access to new and varied information. Each site on the internet has a unique address. This unique address is known as URL (Uniform Resource Locator). A URL indicates the location of the website on the web. If you want to access the site, type in the URL on the Address bar of the web browser and press Enter. In a few seconds the Home Page of the site will appear on the screen. So the information about the link is provided to the browser by the URL. There are typically four main parts to a URL or web address. Let's look at the example below.

http://www.jscoeg.edu.ng/

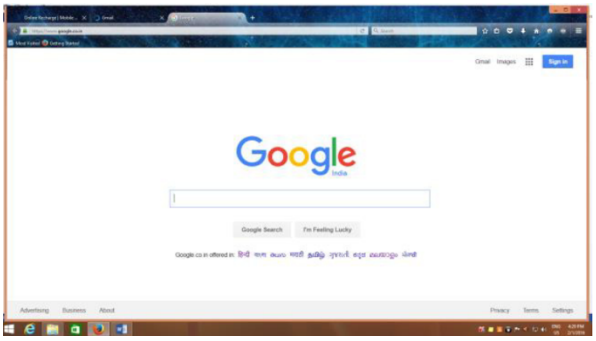
Information Search

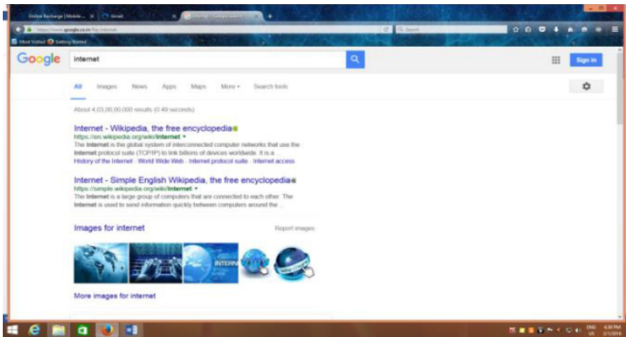
a. The http:// helps your web browser to locate the webpage or website and to display it for you to see. Most browsers will automatically add this prefix, so you don't have to worry about typing it every time.

b. The www stands for World Wide Web. This means that the page you're looking for is somewhere on the World Wide Web. For some websites, it's not even necessary to type in the "www" part.

c. The next section, which is "cmfri" in this example, is the name of the webpage or website. It is flanked by dots on either side which separate it from other sections of the web address.

d. The .org .in here is the top level domain name. A domain name is an identification label that defines a realm of administrative autonomy, authority, or control in the Internet. .org means sites belonging to non-profit organisation, .in means the Internet country code for India. Some common domains are, .com (means that you're looking at a commercial site, or a site that someone has paid to use) .edu (sites for educational institutions) and .gov (sites sponsored by state or central government).





Sometimes you may not know the URL of any website that provides the information, then special programs called search engines can be used to find out the sites. A search engine searches for the keywords specified by the user. It is especially used to find particular site on the internet. Google is the most popular search engine in the world. 79% of internet users use Google as their search engine, followed by Bing (9%), Yahoo (8%), and Ask.com (1.5%). Google is pretty much simple search box. As you begin typing, Google will begin to autosuggest words or phrases which it thinks you might be searching for. Once you do a search, you'll be taken to a new page with results for your search keyword(s). For instance, if you do a search for internet, you will see the list of results for the search "internet." At the top of the page on the far right you will notice it says "Results 1-10 of about...." That means that results displayed on the page right now are just the first 10 of however many total results there were for your keyword.

Internet Safety

Worms, trojans, spammers, phishers and viruses are funny-sounding names, but these are part of the dark side of the internet and the consequences aren't very funny. These are programs designed to infect your computer without your knowledge and they can slow down your computer, spy on you, or possibly even destroy data and cause your computer to "crash" (or stop working). Internet fraud is also something to be concerned about.

Phishing and other scams can cost you time, aggravation, money or even steal your identity. The fact is, the internet can be fun, entertaining, educational, and many other wonderful things, but anyone can be on the internet, and that includes malicious people and criminals as well as good people. In order to be safe online, it's important for you to be aware of the dangers. If you are using

a computer, always be sure to run current, updated antivirus software to help protect yourself from the many different types of computer viruses and other malware. You can also help yourself stay protected from viruses by not opening any emails (especially email attachments) that seem strange or are from people you don't know. To protect yourself scam or theft, avoid giving out personal information on the internet, Think carefully before posting pictures or videos of yourself, never give out your passwords and don't befriend people you don't know. Internet safety is an on-going process that you should continue to educate yourself about.

4.4 Creating an E-Mail Account

Email, short for Electronic Mail, is a component of internet. It is a fast and economic way of sending messages to individuals and groups of people. Messages can include text, pictures or animations.

This section discusses on creation and accession of an email account, opening and reading of received mails and composing and sending mails. Several sites on the internet allow you to create an email account and send and receive email and attachments for free, for example gmail.com, hotmail.com, rediff.com, yahoo.com. This session focus on the services available through Gmail as it is free and is the most popular email service available today.

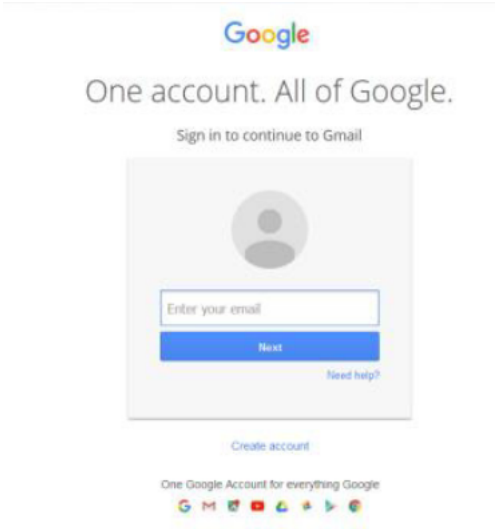
E-Mail Address

To send or receive an email, you must have an email address. This address is unique in nature and it has two important parts. The first part is the 'user name' and the other is the 'domain name'. These two are separated by a special symbol @. The domain name can be same for lots of people. For example cmfri@gmail.com and cmfri1@gmail.com are two addresses with the same domain

name gmail.com. But the user names cmfri and cmfri1 are different and hence the addresses are different.

Setting up an email account

1. Connect to the Internet by double-clicking the Google chrome, Internet Explorer or Firefox desktop icon.



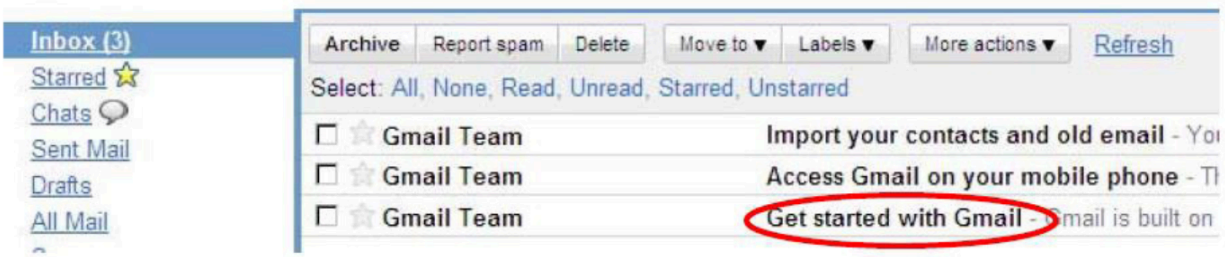
2. Go to the Gmail site by typing gmail.com into the address bar at the top of the screen, and press the Enter key on your keyboard.
3. You should see a screen that looks like this:
4. Click on the Create an Account link at the bottom of the box and following window will be displayed. Complete all starred information in the form, beginning with the Get Started section. Finally, you have to agree to the Terms of Service. Read through the text, and then click "I Agree." So now you have created an email account and your email address is your Google Login Name followed by "@gmail.com."

Checking Your Email

1. Once you have set up your email account, you can check your mail anywhere that you can access the Internet. For this follow the steps given below.
2. Connect to the Internet by double-clicking the Google chrome, Internet Explorer or Firefox icon.

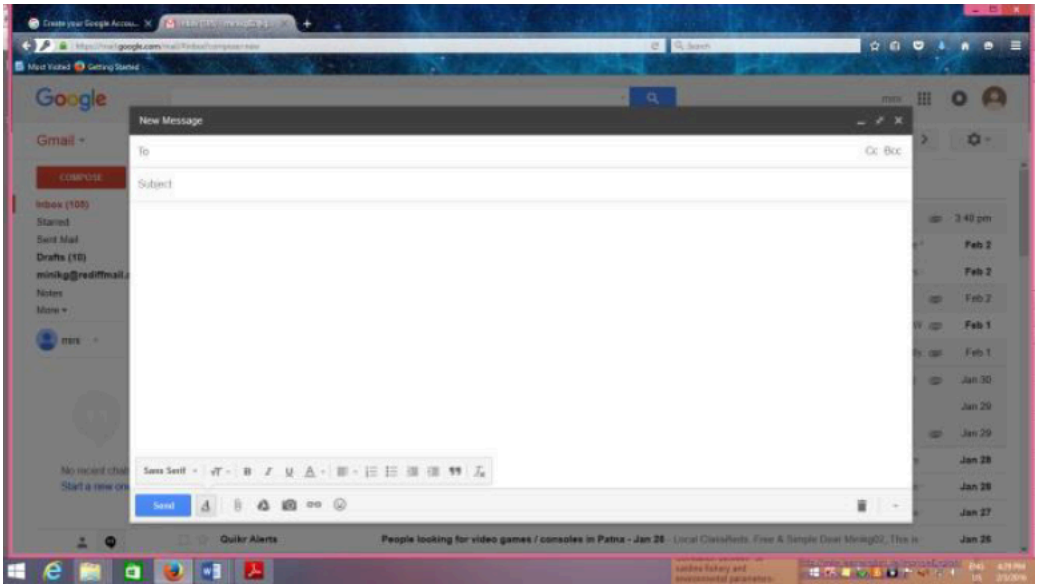
   Go to the Gmail site by typing gmail.com into the address bar at the top of the screen.
3. Type your Google Login Name and Password into the box on the right.
4. The next page will show you the number of new messages in your Inbox.

The inbox is where all of your incoming messages are stored. Click on the subject of the message to open and read it.



Composing and Sending Messages

To create a new message, click the Compose button on the top left side of the screen. Type the email address of the person(s) to whom you wish to send the email in 'To'. Once you have completed your message, send it by clicking on the Send button at the bottom of the window.



Gmail Help

For any help in connection with Gmail, Help link is given at the top right corner of the Gmail page.

4.5 Summary

Internet is a worldwide system of interconnected computer networks.

Computer/mobile, communication channel, modem, browser and Internet Service Provider are needed to connect to internet.

A software called browser helps to display the text and graphics available in a webpage on your computer. Google chrome, internet explorer, Mozilla Firefox are some of the popular browsers.

An Internet Service Provider (ISP) such as BSNL, Idea, and Airtel is required to provide connections to homes and offices.

WWW enables to access information stored in computers connected to the internet. Web consists of millions of websites.

Moving from one site to another on Web is called surfing the Net.

Each site on the internet has a unique address. This unique address is known as URL.

E-mail is an internet facility that helps to send messages to individuals and groups.

4.6 Assessment Question

1. Define the internet from global, network and volume of information resources
2. Identify the types of resources available on the internet.
3. Highlight the importance of the internet to the academic community.
4. Differentiate between the internet and World Wide Web?

Module 3: Introduction to Basic Programming

Unit 4: Installation of Operating System and Application Packages

Flow of the Unit

4.0 Objective
4.1 Introduction
4.2 Installation of Operating System
4.3 Searching for Information
4.4 Creating an E-mail Account
4.5 Summary
4.6 Assessment Question
4.7 Reference

4.0 Objective

a. Define the Operating system.
b. Understand the steps of installing operating system.
c. Able to install windows operating
d. Describe the idea application packages explain the significance of versions, releases, and compatibility
e. Comprehend the core functions of application packages

4.1 Introduction

Operating System

Installing an operating system was once somewhat challenging; however, it is no longer the case. Is that correct? Numerous videos on YouTube facilitate the straightforward installation of an operating system on your personal computer.

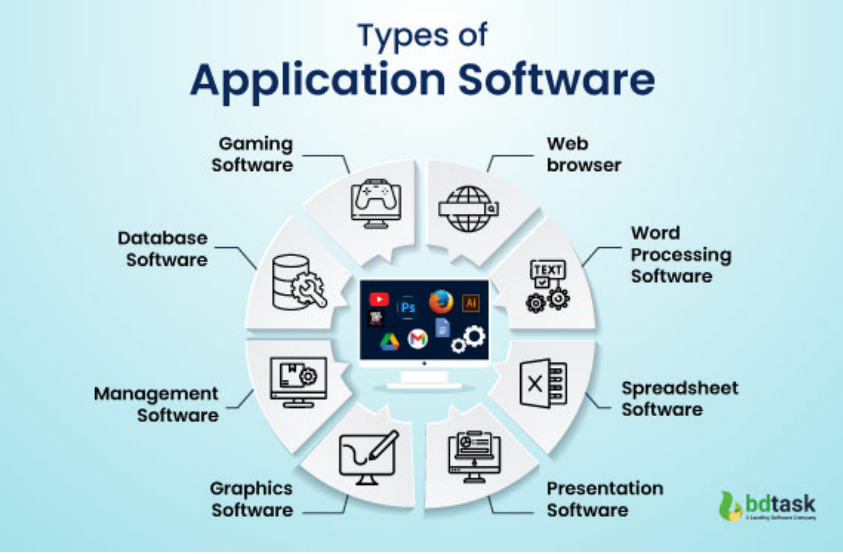
*Source: https://miro.medium.com/v2/resize:fit:638/1*nDRbCic4-ibScjnNjnPskQ.jpeg*

Definition of Operating System

An operating system (OS) is a software that controls a computer's resources, particularly the distribution of those resources across various applications. Common resources include the central processing unit (CPU), computer memory, file storage, input/output (I/O) devices, and network connections. Management responsibilities include the coordination of resource allocation to prevent disputes and disruptions across projects. In contrast to most programs that do a job and then terminate, an operating system operates continuously and ceases only when the computer is powered off (David Hemmendinger, Oct 21, 2024).

Application Packages

This unit is to provide an introduction to the topic of application packages. Also, this section will expose you to the ideas of versions, releases, and compatibility as they pertain to application packages. Getting to know about application packages will be both entertaining and an enriching computer application experience.



Source: https://www.bdtask.com/blog/assets/plugins/ckfinder/core/connector/php/uploads/images/Types-of-application-Software.jpg

Definition of Application Packages

Software's may be described as a collection of instructions that guide a computer on how to do certain activities. Applications software is software that has been built to conduct helpful work on specific tasks, or particular difficulties, or offer pleasure for users. As users, you engage with the application's software. System software allows the applications software to interface with the computer and helps manage its internal resources. Generally, it is viewed as any collection of

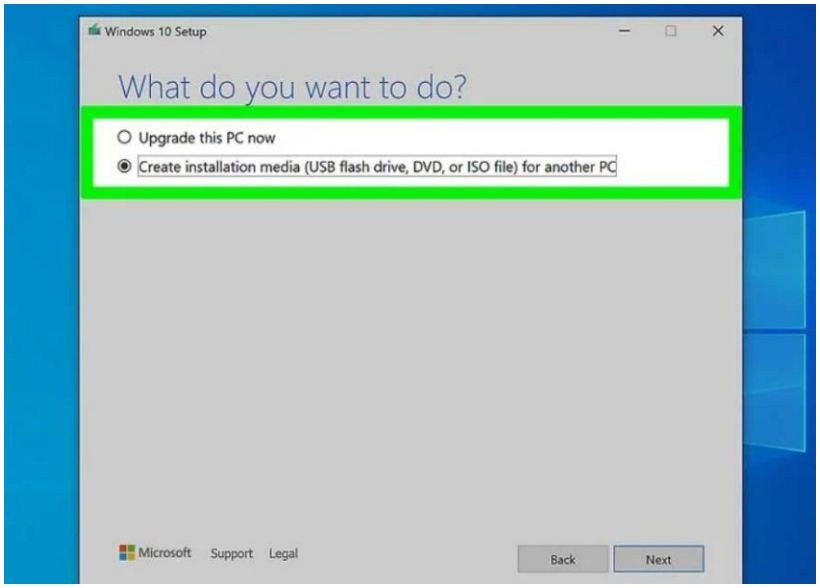
directives that instructs or informs the hardware how to complete a certain job. If you purchase a new microcomputer at a shop, you will discover that certain bundled software have already been loaded on it. This often contains system software (e.g., operating system) and different kinds of applications software compatible with it. Application Software's are programs created for end users which enable end-users to execute a set of defined activities. This may involve among others i.e., programs to identify answers to users' concerns.

As has been previously, the software may be classified into systems software (i.e., these are programs meant to govern the execution and usage of other programs and hardware efficiently) and applications software (i.e., these are programs to answer users' issues). Systems software is often given by hardware makers. In this part, let us look at some general aspects about applications software. Applications software contains the technique and guidance which allow computer systems to achieve what the user expects. Software design mainly comprises three abstract notions. These are algorithms, data structures, and file structures.

Algorithms are just the stages for computing. They may either be numerical or non-numerical, for example, sorting, text searching, etc. Data structures, on the other hand, show how information is structured in the computer's memory.

4.2 Installation of Operating System (Windows)

Create a window installation media



Creating Window Installation - First step towards installing an operating system

If you order any window whether it is window 10 or the newest one that's window 11. You will get a window installation CD along with your brand-new PC. If you don't obtain a DVD disc of window installation, then still you may install an Operating system (OS) on your PC. Let's look at depth, how to construct window installation media.

Requirement:

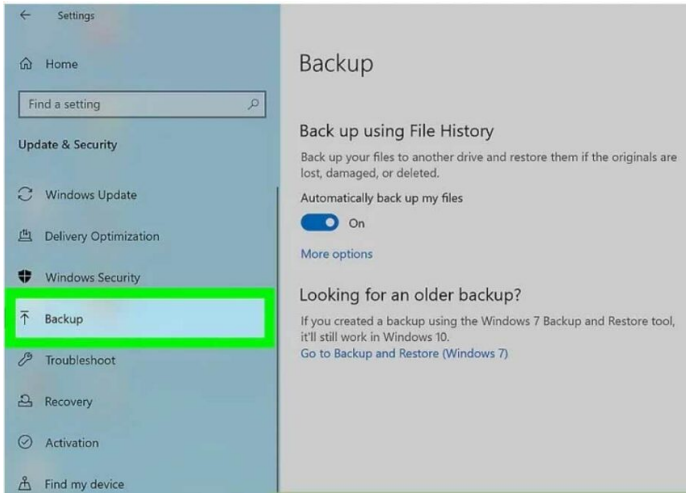
- Minimum 8 GB of Pen Drive.
- A computer having an internet connection.

You need to download windows of your choosing whether it's 10 or 11. You may get it from the official website of Microsoft. Or have a look at step-by-step tutorial to download windows. After you have successfully downloaded the .exe file, please follow the procedures below:

Steps to produce installation media

- Plugin a flash drive
- Download a tool MediaCreationTool.exe
- Run it, and click on accept
- Select installation media (DVD/ISO, USB Drive) from another PC and click next
- Select your language, windows edition and PC architecture and click NEXT
- Now, you need to pick the USB Pen drive and click NEXT

Backup your files (optional)

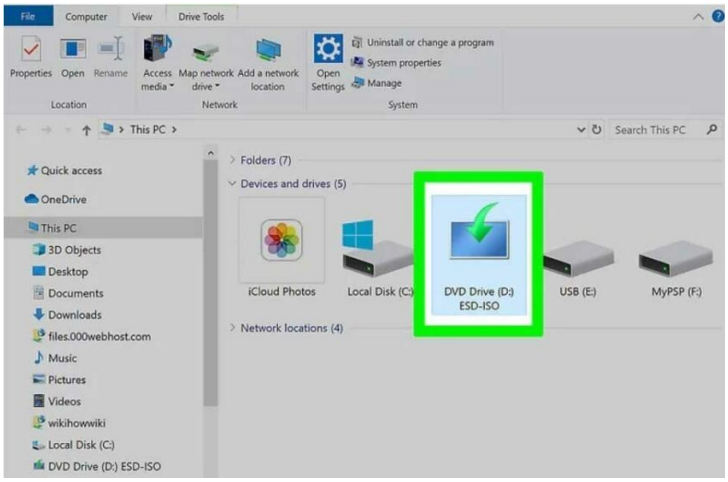

Settings
Home
Find a setting
Update & Security
Windows Update
Delivery Optimization
Windows Security
Backup
Troubleshoot
Recovery
Activation
Find my device
Backup
Back up using File History
Back up your files to another drive and restore them if the originals are lost, damaged, or deleted.
Automatically back up my files
On
More options
Looking for an older backup?
If you created a backup using the Windows 7 Backup and Restore tool, it'll still work in Windows 10.
Go to Backup and Restore (Windows 7)

Operating System need to back up files if you are installing first time It's an optional step to perform, as in case you are upgrading your existing operating system to the newest. You are

necessary to take back up. You may back up your data to Google Drive, DropBox, One Drive, USB Flash Drive and other external hard drives. Otherwise, You may keep it as it is.

For a fresh installation, you don't need to do anything with this option.

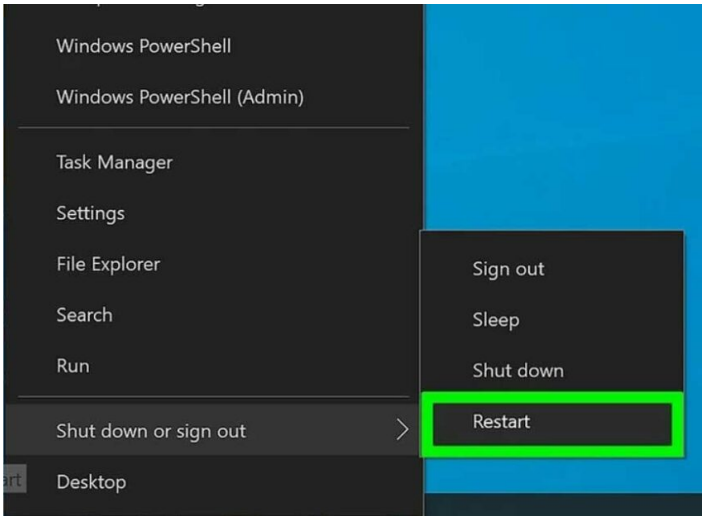
Insert Window installation media to Computer



Insert Window Installation Media to Computer

Now, It's time to input a media installation (USB or DVD) into your computer. Make sure all the windows files have been transferred to your flash drive.

Boot the computer



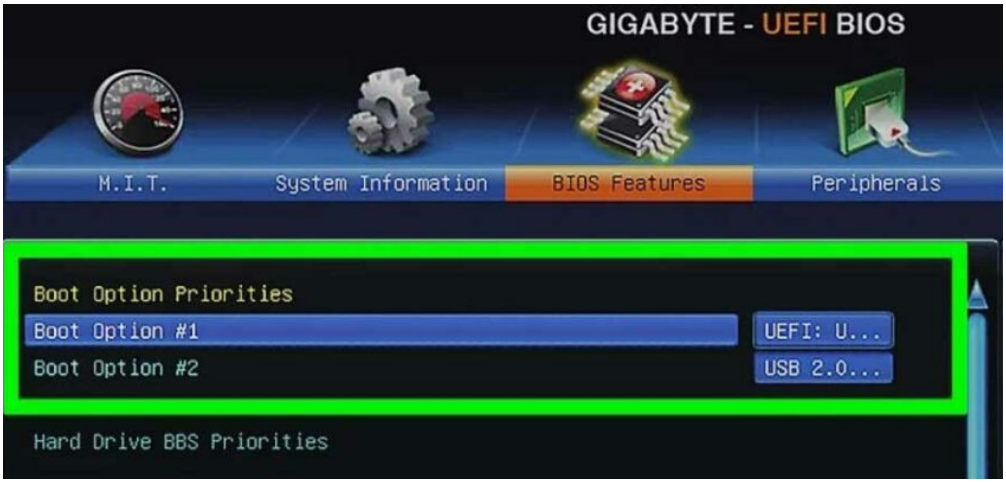
Boot the computer: It explains that you may boot or ***restart*** the computer. As you are ready click on the windows icon and pick the option "***Shut down or sign out***" and then "Restart". When your

pc restarts, you need to hit ***F10, F11, F12***, or ***ESC*** in order to access the boot menu. Note: These keys could be different in your computer since every computer is constructed differently.

I suppose this could assist you.

If you possess an ancient computer, you may hit ***F1, F2, F3, or ESC*** to access the BIOS (Basic Input Output System).

Select the USB Drive



This offers two boot choices, and you may pick USB Drive wherever the operating system is installed

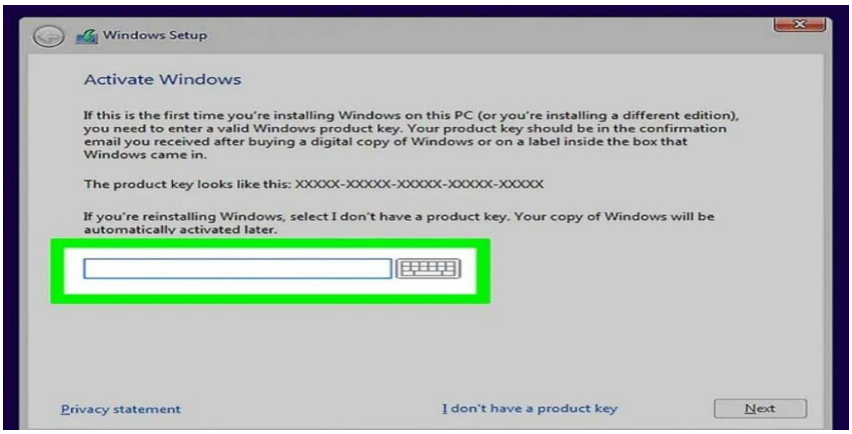
Select BIOS Features option

In Boot Options Priorities, Select the Boot Option #1. Click it and pick the flash drive option.

Install Now

After you pick the proper USB option for window installation. You will notice a screen flashing "*Install now*". Click on "*Install now*" and proceed to the next step.

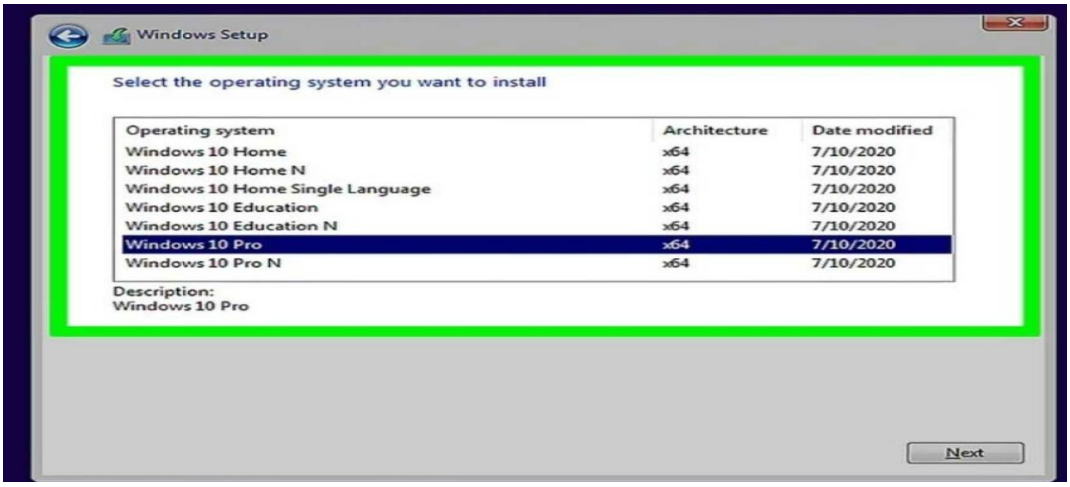
Enter your windows product key and click next


Windows Setup
Activate Windows
If this is the first time you're installing Windows on this PC (or you're installing a different edition), you need to enter a valid Windows product key. Your product key should be in the confirmation email you received after buying a digital copy of Windows or on a label inside the box that Windows came in.
The product key looks like this: XXXXX-XXXXX-XXXXX-XXXXX-XXXXX
If you're reinstalling Windows, select I don't have a product key. Your copy of Windows will be automatically activated later.
Privacy statement
I don't have a product key
Next

Activate Windows: Asking for entering product key

You must have the windows product key. But it's alright if you don't have one right now, you may skip this stage when picking the option "I don't have a product key". But, at the conclusion of the installation, it will ask you for the product key. You may locate your product key in your inbox if you have purchased it from Microsoft officially. or if you have purchased it in DVD format, You may find the key in its envelope. Well, if you don't have purchased it until now you need to get it for a flawless experience.

Select the edition of window you wish to install



Windows Setup: It is presenting up the list of operating systems version like x64 and its architecture. Windows operating system comes in two-bit variants 32-bit and 64-bit. x86 signifies 32-bit while x64 denotes 64-bit.

Difference between 32-bit and 64-bit

- "The 32 bit OS can store and handle lesser data than the 64 bit OS. it addresses a maximum of 4,294,967,296 bytes (4 GB) of RAM. The 64 bit OS, on the other hand, can process more data than the 32 bit OS."
- x86 or 32-bit operating system supports only 32-bit software package.
- x64 or 64-bit operating system supports both 32-bit and 64-bit software programs. So, as per your demand.

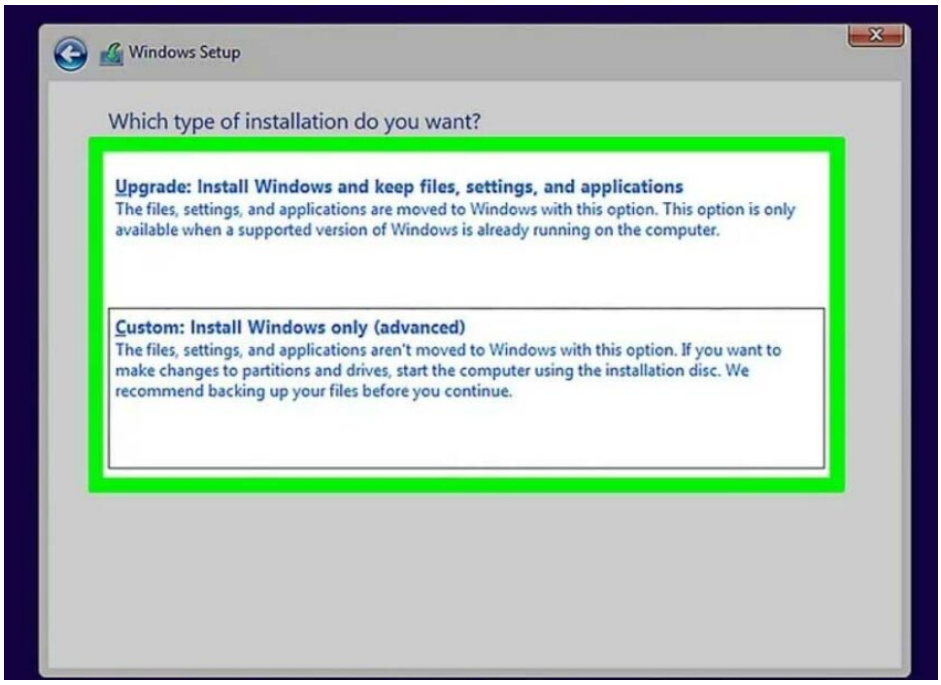
You may select which version is best acceptable for you. If you still don't know which version of the operating system to install, then you may opt for "Windows 10 Home" generally utilized OS for home computers. So, when you have picked, which version of OS to install, now click "***NEXT***".

Accept License Term "I accept the license terms"

Windows Setup
Applicable notices and license terms
Last updated June 2018
MICROSOFT SOFTWARE LICENSE TERMS
WINDOWS OPERATING SYSTEM
IF YOU LIVE IN (OR IF YOUR PRINCIPAL PLACE OF BUSINESS IS IN) THE UNITED STATES, PLEASE READ THE BINDING ARBITRATION CLAUSE AND CLASS ACTION WAIVER IN SECTION 11. IT AFFECTS HOW DISPUTES ARE RESOLVED.
Thank you for choosing Microsoft!
Depending on how you obtained the Windows software, this is a license agreement between (i) you and the device manufacturer or software installer
I accept the license terms
Next

Before moving further, you are needed to accept the licensing conditions and then click next to begin the installation.

Choose: Custom install window alone or Upgrade:

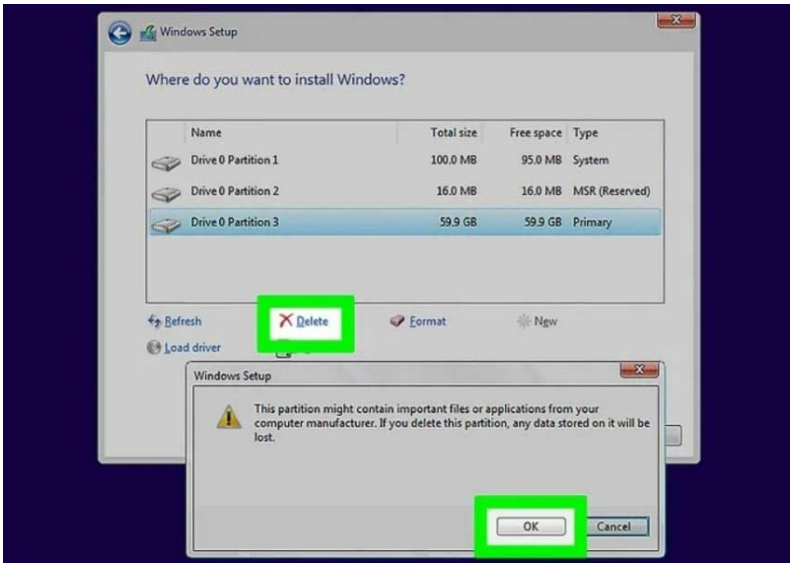

Windows Setup
Which type of installation do you want?
Upgrade: Install Windows and keep files, settings, and applications
The files, settings, and applications are moved to Windows with this option. This option is only available when a supported version of Windows is already running on the computer.
Custom: Install Windows only (advanced)
The files, settings, and applications aren't moved to Windows with this option. If you want to make changes to partitions and drives, start the computer using the installation disc. We recommend backing up your files before you continue.

Choose: Upgrade or Custom Installation

Upgrade: This option is handy if you are installing the newest OS to your current supported versions of the operating system.

Custom Installation: This option is handy if you are installing OS to your fresh new or current machine, which doesn't have an OS.

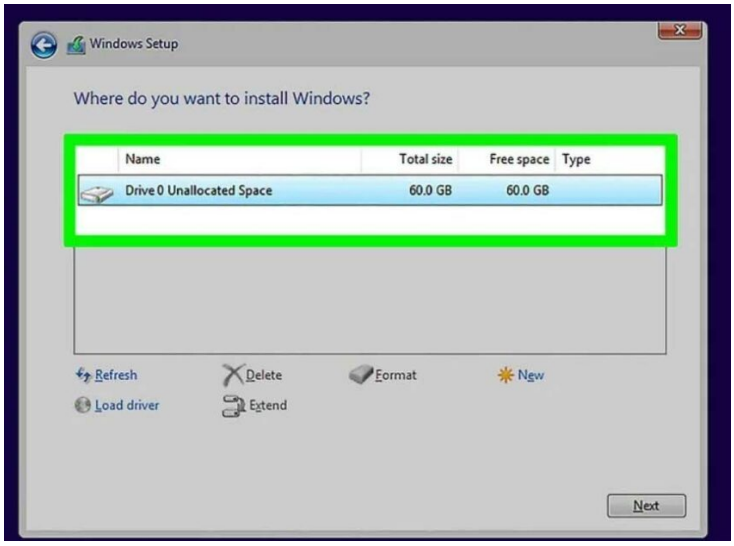
Select a disk or partition



Select the partition for window installation

Choose the right partition where you are going to install your operating system and then click on “Delete”.

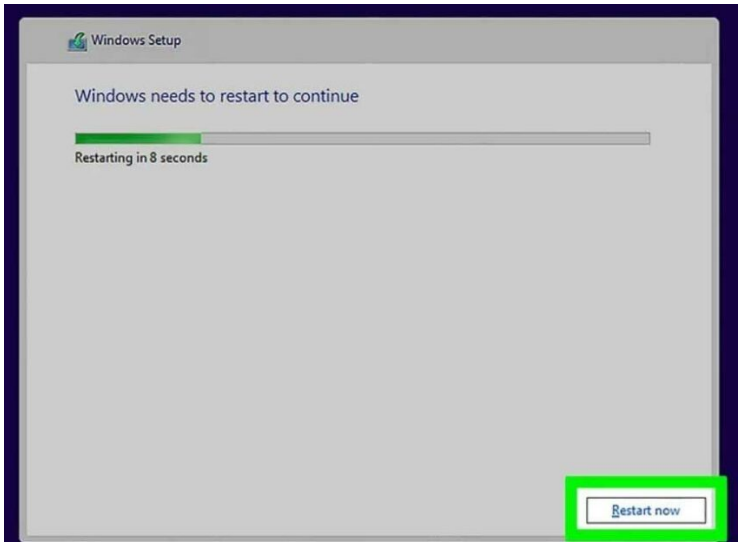
Select a disk with unallocated space and click “Next”



Select a disk with unallocated space and click

Choose the disk with unallocated space and click “Next” to begin the installation of windows. This could take little time to transfer data to your hard disk, once it’s done you can go on to the following stage.

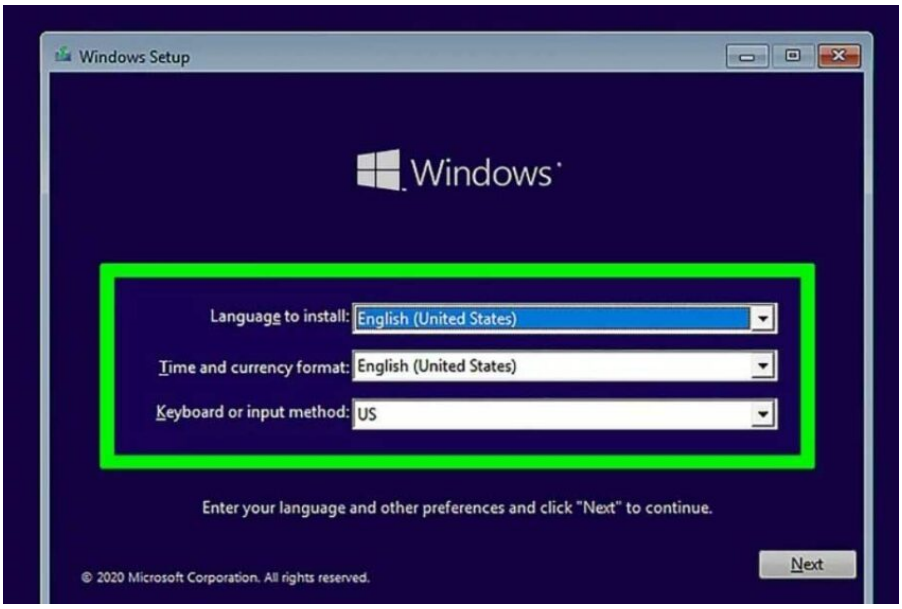
Remove the USB flash device and restart your computer.



As you can see, you have successfully installed the operating system on your PC. Now, You may remove the USB flash device and restart your computer.

Let’s now speak about how to set up windows.

Setting Up Windows


Windows Setup
Windows
Language to install: English (United States)
Time and currency format: English (United States)
Keyboard or input method: US
Enter your language and other preferences and click "Next" to continue.
© 2020 Microsoft Corporation. All rights reserved.
Next

Select your language time and currency and keyboard input

For setting up windows, you needed just a few actions as given below:

- Verify your region and keyboard input
- Connect to your Wireless network.
- Select for Personal usage or Organizational usage and click next

Sign in to Windows

- Click “***Accept***” to Set up Cortana
- Click “Yes” and follow steps to set up the Windows timeline
- Choose your privacy options and click “Accept“

This will take a few more times to set up your windows. Now, you may sit comfortable and wait for the setting up. As it’s done, you may utilize your computer as you please.

4.3 Versions, Releases, & Compatibility

After some interval software developers upgrade their goods and bring forward new versions or fresh releases. Although not all software developers use the phrases consistently, their recognized meanings are as follows.

Version:

A version can be considered to be a substantial update of a software program. Traditionally versions have been signified by numerals such as 1.0, 2.0, 3.0, and so on. The greater the number before the decimal point, the more recent the version. In recent years, several software developers have diverged from this framework. An example is when Microsoft debuted Windows 95" instead of calling it windows 4.0

Release:

A release may be considered to be a small improvement. Release is signaled by modifying the number after the decimal point 4.0, then 4.1, then potentially 4.11, then 4.2, and so on.

Compatibility:

Compatible means what has been created or modified in earlier versions of the software may be processed effectively by later versions. Compatible also indicates that a new version of an applications program will operate with the system software you are presently using. To minimize difficulties emerging from incompatibility it is essential to study the software package before purchasing it.

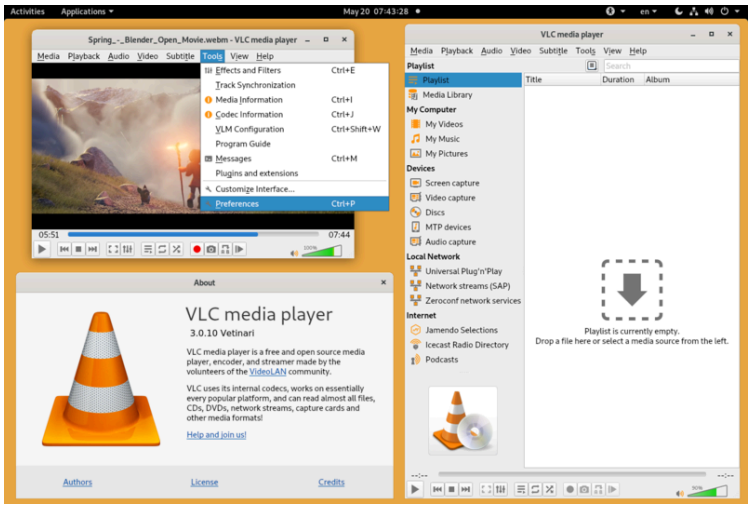
4.4 Entertainment Software

Entertainment Software refers to a broad range of software; it may apply to video games, software for viewing films or playing music, showing photographs, and other types of entertainment which people can enjoy via a computer device. It may also be argued that entertainment software is kind of software that gives options for leisure activities or any sort of amusement.

We may argue that owing to the wide definition of entertainment software, there is quite a lot of software that comes into this category. One of the most well-known categories of entertainment software is video games or the gaming industry, We can see how popular video games are if we

take a look around, from adventure games like tomb raider to sports games like FIFA and NBA to action games like Call of Duty to simple games like candy Crush, and it's not all games that are for leisure purposes; we also have educational games like Hangman, Scrabble, etc. Video games have been around since the '70s and they have grown swiftly to the point where modern-day games virtually seem as good as the real world. The initial set of video games was not as realistic as contemporary games; they had minimal visual representation and were modest in size, as little as a few MB compared to modern games that are nearly as huge as 100 GB. We had popular games like Pac-Man, Space Invader, Pong, etc. that introduced people to video games and it didn't take long until the audience fell in love with video games, which led to the invention of more and more video games.

Another area is the media software; this might be for media production and editing or for playing media files (movies and music). Though this category may not be as famous as the gaming area, they are nonetheless pretty well recognized. We also have numerous applications for viewing movies like VideoLAN (VLC), KMPlayer:, Netflix, etc., or listening to music like iTunes, Deezer, etc. All this software allows us to view films or listen to music on our Computers. We also have tools for generating or editing film and audio, which include Sony Vegas pro, adobe Photoshop, shazam, sound cloud, virtual DJ, etc. both the video and music editors operate similarly; they may create, replace, erase, alter, transform and do anything to the frames on the screen.



This has offered unlimited options for content makers and professional professionals. educational reasons. youngsters want to be amused, they love to have fun, and it is also simple to train youngsters via educational games or films. This is often employed in contemporary classrooms, and it has shown to be quite effective. Educational games come in numerous kinds and sizes; some are generic while others give a more focused educational experience. Examples include Minecraft, which is utilized by architecture schools for the project, and Kahoot, which may be stated to be an instructional platform. Overall, there are so many various methods to educate kids while having fun that it's a fantastic thing that such software exists. Because this means contemporary youngsters have many new options to be engaged in learning and have fun while doing it.

All this illustrates that entertainment software plays a significant part in our everyday lives, from movies to music to video and music editing to instructional games.

Home/Personal Software

Personal software or Personal application software may be considered to be software one uses for their purpose, this suggests that it is software you use to achieve a given job that pertains to you. Technically, personal software does not have to be unique, it only needs to be software that multiple users may use for their purpose. It is also known as home application software since it is designed for home, private usage.

Most software that we use is personal software because of various reasons apart from being intended for home and private use, they come most times with instructional use, they are

comparatively cheaper than any other category of application software, they also increase personal productivity and effectiveness.

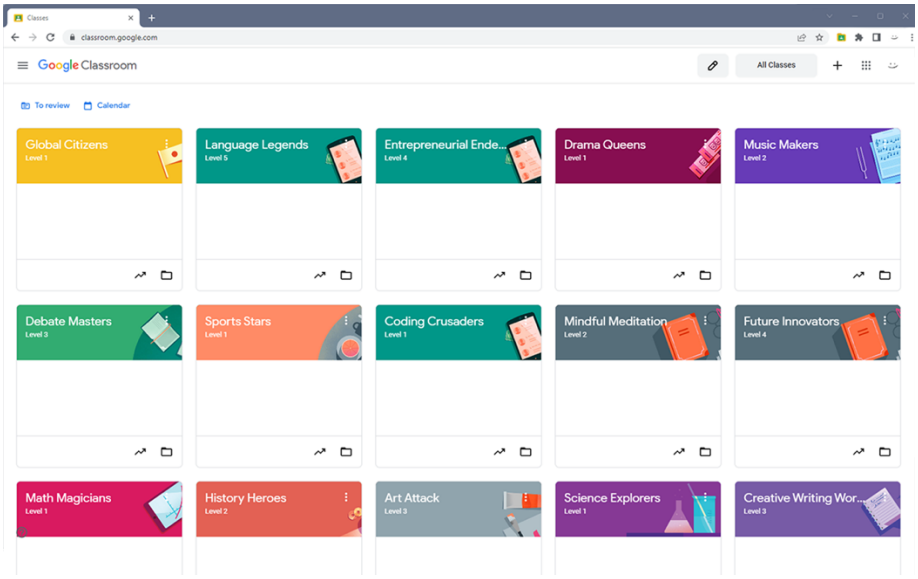
Based on this definition of personal software, we can offer an example of personal software, which is Microsoft Office. Microsoft Office is recognized as an example of personal software since it caters to a lot of tasks in our everyday life; for example, Microsoft word is used for typing documents like research papers, projects, lecture notes, assignments, etc. Microsoft Office is also one of the most popular, if not the most popular, personal software in the world today; aside from that, it is also incredibly inexpensive to obtain and simple to use. Other examples include our numerous web browsers, including Google Chrome, Safari, Firefox, Explorer, etc.; these allow us to have access to the web and to surf it. The unifying aspect among all these cases is that one, we employ them for personal objectives. Two, we employ them in our regular tasks. Three, they are inexpensive to buy, and most even come together with our gadget, and fourth, they boost personal efficacy.

4.5 Education/Reference Software and Productivity Software

Educational/Reference Software

Educational software are applications that are generally intended for teaching and learning. It encompasses a broad spectrum of varied uses, going from language learning software to reference software to classroom management software to video instruction software, etc. The promise of educational software was recognized early by educational experts; this led to educational software

coming practically with the first desktop computers. Educational software covers a large area of different forms, costs, and purposes, some exist to instruct children on various letters in the alphabet, others include introducing complex concepts to all grades, some are also for developmental purposes in the aspect of good writing skills, good speaking skills, etc. others are created for training experts different intricacies of their work, etc. such examples are Encarta, Google Classroom, Litmos, Moodle, etc.



There are several categories of educational software, which include: One, courseware; these are supplementary resources that may either be designed as kits for instructors or tutorials for students, in most situations, they are papers intended to give more help. Two, Classroom Aids, are particularly created for use in school classes. When such software are employed, they are often shown on huge whiteboards, e.g. Moodle. Three, specialized Educational Purpose: they are extremely specialized software that is intended primarily to educate on a certain topic or instruct on a specific activity, e.g. driving test software, language learning software, etc. Other categories include corporate training, bespoke platforms reference software, and assessment software.

Productivity Software

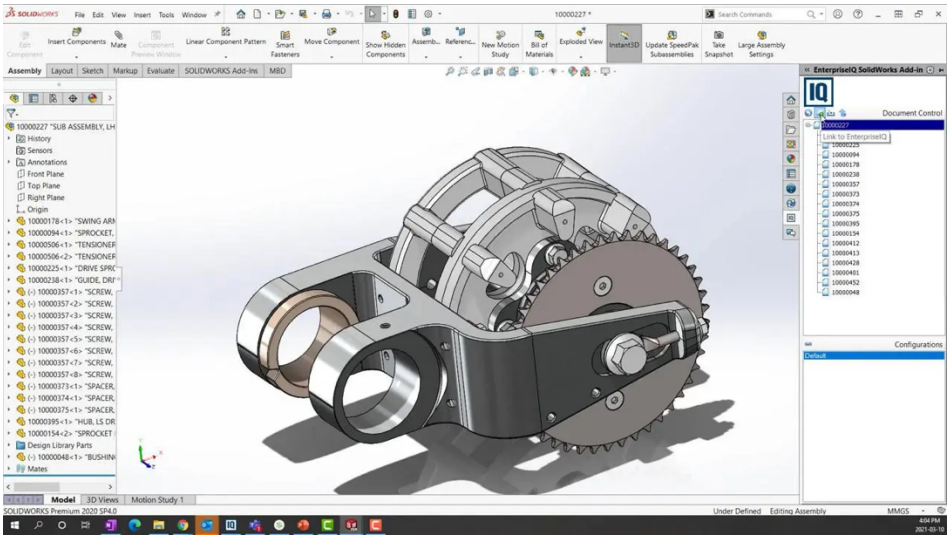
Productivity software, much as the name says, is used for the creation of information, which might be in the form of databases, papers, workbooks, charts, graphs, etc. It is largely used for enhancing productivity, particularly among office workers. A package of productivity software meant to be used by office professionals is known as Office Suite. The components are often distributed together, have a uniform user interface, and usually can interact with each other.

The most common forms of productivity tools are:

- Wordprocessingsoftware
- Spreadsheet software θ Database software, including personal information managers
- Financial software, including personal financial applications
- Software for cyberspace communications, e-mail, Web browsers θ Integrated software and packages.
- It may still be feasible to work in an office these days without understanding any of these applications. However, it probably won't be the case as we go ahead into the 21st century. We will cover productivity software in greater depth, commencing in another few pages.

Specialty Software

Whatever your vocation, you will undoubtedly discover it has specialist software accessible to it. This is true whether your work is as an architect, construction contractor, pilot, etc.Some applications assist architects or engineers to be able to mimic buildings before creating them. Other applications assist construction estimators bring together the prices of goods and manpower required to estimate a project.



4.6 Summary

Various kinds of application software enable to carry out various duties ranging from education-related tasks to enjoyment. Users decide which of these categories they install based on their requirementsIn this section, we have gone over the five primary kinds of application packages. It is apparent that consumers have the opportunity to install any or all of the categories.

4.7 Assessment Question

1. What are the differences between system and application packages?
2. What do you understand by compatibility of application software?
3. List the various categories of application software you know.
4. What are the most popular productivity tools?
5. What are the most popular productivity tools

Module 3: Introduction to Basic Programming

Unit 5: Introduction to Electronic Data Processing (EDP) Concept and Career Opportunities

Flow of the Unit

5.0 Objective
5.1 Introduction
5.2 Techniques of Electronic Data Processing (EDP)
5.3 Element of Electronic Data Processing
5.4 Stages of Electronic Data Processing
5.5 Summary
5.6 Assessment Question
5.7 Reference

5.0 Objective

a. Define the Electronic Data Processing (EDP).
b. Understand multiple possible techniques of EDP.
c. Describe many career options surrounding EDP
d. Describe the application of Electronic Data Processing
e. Understand advantages and disadvantages of EDP

5.1 Introduction

Electronic data processing, sometimes referred to as EDP, denotes the automated processing of information. It use computers to alter, record, categorize, and summarize data. Electronic data processing (EDP) refers to the manipulation of data using electronic devices, including computers, calculators, servers, and analogous equipment. A computer exemplifies an electrical data processing equipment. Electronic data processing is a precise and expeditious technique for data processing.

5.2 Techniques of Electronic Data Processing (EDP)

Numerous data processing methods exist, although several techniques are particularly prevalent in the realm of electronic data processing. These strategies are extensively used across almost all industries. Based on the specific requirements of data processing, many prominent approaches of electronic data processing are delineated below:

- Time-Sharing

- Real-time processing
- Online processing

- Multiprocessing
- Multitasking
- Interactive processing
- Batch processing
- Distributed processing

Each kind is detailed below in brief:

Time-sharing: In this processing mechanism, multiple nodes linked to a CPU accessible central computer. A multi-user processing system manages the time allocation to each user. Each user may assign the time slice in a sequence of the Central Processing Unit. The user should accomplish the job throughout the allotted time slice. If the user cannot accomplish the work, then the user may complete the task within another assigned time slice.

Real-Time Processing: Providing accurate and up-to-date information is the major purpose of real-time processing. It is feasible when the computer processes the incoming data. It will offer a quick answer to what may happen. It would effect the next events. Making a reservation for rail and plane tickets is the greatest example of real-time processing.

If the seats are booked, then the reservation system changes the reservation file. The real-time processing is virtually an instantaneous method to receive the output of the information. This strategy saves the greatest time for receiving output.

Online Processing: In this processing approach, the data is processed immediately it is received. A communication connection enables to connect the computer to the data input equipment directly. The data input may comprise a network terminal or online input device. Online processing is generally utilized for information inquiry and recording.

Multiprocessing: Multiprocessing is the processing of more than one job that employs the various processors at the same time on the same computer. It is feasible in network servers and mainframes. In this method, a computer may consist of more than one separate CPU. This makes data processing significantly quicker.

There is a chance to create cooperation in a multiprocessing system. In this technique, the various processors share the same memory. The processor obtains the information from a distinct component of one program or several applications.

Multitasking: It is a fundamental characteristic of data processing. Working with various processors at the same time is termed multitasking. In this procedure, the multiple tasks share the same processing resource. The operating systems in the multitasking process are time-sharing systems.

Interactive Processing: This approach has three kinds of functions. The following are the kinds of function

- Peak detection
- Integration
- Quantitation

It is an easy approach to operate with the computer. This way of the procedure might compete for each other.

Batch Processing: Batch processing is a way of processing the structured data into separate groups. In this strategy, the processing data may be separated as a group across a desired time period. The batch processing approach enables the computer to conduct varied priorities for an interaction. This strategy is highly unique and handy to process.

Distributed Processing: This approach is commonly used for remote workstations, as the distant workstations are linked to a large workstation. The clients obtain better services via this method. In this technique, the corporations may spread the usage of geographical computers. The finest illustration for this distributed processing mechanism is ATMs. ATMs are linked to the banking system.

5.3 Elements of Electronic Data Processing

Hardware, software, processes, and staff are the core aspects of electronic data processing. In the hardware segment, scanners, barcode scanners, cash registers, personal computers, medical devices, servers, and video and audio equipment are the components of electronic data processing.

In the software sector, accounting software, data input, scheduling software, analytics, and software are the components of electronic data processing. In the method segment, sorting, analysis, reporting, conversion, data collecting, and aggregation are the aspects of EDP.

In people, the programmer employs the electronic data processing to produce the components and spreadsheets. The data entry professionals utilize to scan the barcodes. The relevance of data processing is now realized by all the sectors. Each industry now focuses on what works best for them and how to create more revenues.

5.4 Stages of Electronic Data Processing

A collection is the initial step of electronic data processing. It is a very vital aspect. In an EDP system, this step assures that correct data collecting. Census, sample survey, and administrative by-product are some methods of data collecting. Preparation is the second step of electronic data processing. Preparation is used to examine the data processing.

Input is the third step in electronic data processing. Data input is done by the use of a scanner, keyboard, and digitizer. The fourth step is processing. It has several techniques. The penultimate step is storage. Every computer has the use to store the file.

Advantages of Electronic Data Processing

1. Once the system of electronic data processing is built, the cost of handling data will be lowered. Documents may be safeguarded as extreme data sensitive. Because the papers should be viewed as a major asset. When all the information is gathered by the publications, the tough one.
2. The handling of papers is expensive. So, computerized data processing minimizes the expense of the paperwork. The electronic data processing gives the documentation controls. With the aid of electronic data processing, you may effortlessly automate the PDF publication process.
3. In electronic data processing, there is a feature to search a document in the system. It will decrease the time lost. The electronic data processing offers the advantage of boosting internal and external cooperation. The computerized data processing helps to enhance the submissions.

4. The electronic data processing also speeds up the overall structure to make the creation of papers.

   The prominent software product, such as Microsoft Office, is employing the electronic data processing principle. The EDP has the capacity to eliminate the duplication of effort and repetitive entries. The EDP has the capacity to make the choices. An electronic data processor has the potential to store vast volumes of data, and this data may then be further exploited for data display and analysis.

Disadvantages of Electronic Data Processing

1. When the computer hackers make the assault on the computer, then the processing of data will cause the vulnerability. Then the data will be the lost. The malfunction in equipment will affect all the equipment in the office. The security of the computer would be the primary challenge. In a coding procedure, a computer does not identify the same humans.
2. When a limited number of digit codes are compared with a huge number code, then it fills the computer storage less. The alphabetic codes might be descriptive.

Examples of EDP: It is used in a telecom firm to structure invoices and to compute the usage-based charges. In schools, they employ EDP to keep student records. In shops, it is used for recordkeeping, while hospitals utilize it to track the progress of patients.

5.5 Summary

Electronic data processing is employed for hotel bookings. It may be utilized in learning institutes. The EDP is also used in banks to monitor the transactions. In departments such as police, cybercrime, and chemical, computerized data processing is employed to note the entries. It allows bigger businesses to acquire the information and analyze the data. The electronic data processing may also be employed as video and audio equipment. It may be used as a barcode scanner.

5.6 Assessment Question

1. Define electronic data processing and explain its importance in modern business operations.
2. List and describe three common applications of EDP in organizations.

3. What skills are essential for a career in EDP? Provide at least three examples.
4. True or False: EDP only involves manual data processing methods.
5. True or False: Careers in EDP are limited to programming and software development.
6. Discuss the evolution of electronic data processing from manual methods to current automated
7. systems. What are the implications for businesses?
8. Analyze the various career opportunities available in the field of EDP. How do these roles
9. contribute to organizational success?
10. Evaluate the impact of emerging technologies (such as AI and cloud computing) on the future of EDP. What new career opportunities might arise as a result?

Module 4: Number System

Unit 1: Basic Number System

Flow of the Unit

1.0 Objective
1.1 Introduction
1.2 Conversion between base
1.3 Summary
1.4 Assessment Question
1.5 Reference

1.0 Objective

a. Describe System Development Life Cycle (SDLC).
b. Able to describe each stage involve in implementing SLDC.
c. Identify stages involve in SDLC

1.1 Introduction

Many distinct number systems presumably from the ancient times have been devised and evolved. Among these, binary number system is one of the simplest and effective number systems, and has been widely employed in digital systems. Studying number systems may help you comprehend the fundamental computing operations using digital systems.

Number System

Number systems are the way to represent numbers in the computer system architecture, every value that you are storing or retrieving into/from computer memory has a specified number system. Computer architecture supports following number systems.

- Binary number system
- Octal number system
- Decimal number system
- Hexadecimal (hex) number system

Binary Number System

A Binary number system contains just two digits that are 0 and 1. Every number (value) symbolizes with 0 and 1 in this number system. The basis of binary number system is 2, since it contains just two digits.

Octal Number System

Octal number system comprises just eight (8) digits from 0 to 7. Every number (value) symbolizes with 0,1,2,3,4,5,6 and 7 in this number system. The basis of octal number system is 8, since it contains only 8 digits.

Decimal Number System

Decimal number system includes just ten (10) digits from 0 to 9. Every number (value) corresponds with 0,1,2,3,4,5,6, 7,8 and 9 in this number system. The basis of decimal number system is 10, since it contains only 10 digits.

Hexadecimal Number System

A Hexadecimal numeral system includes sixteen (16) alphanumeric values from 0 to 9 and A to F. Every number (value) symbolizes with 0,1,2,3,4,5,6, 7,8,9,A,B,C,D,E and F in this number system. The basis of hexadecimal number system is 16, since it contains 16 alphabetic values. Here A is 10, B is 11, C is 12, D is 14, E is 15 and F is 16.

Number System	Base (Radix)	Used digits	Example
Binary	2	0,1	$(11110000)_2$
Octal	8	0,1,2,3,4,5,6,7	$(360)_8$
Decimal	10	0,1,2,3,4,5,6,7,8,9	$(240)_{10}$
Hexadecimal	16	0,1,2,3,4,5,6,7,8,9 A,B,C,D,E,F	$(F0)_{16}$

1.2 Conversions

1.2.1 Decimal to Other

1. Decimal to Binary

Decimal Number System to Other Base

To convert Number system from ***Decimal Number System*** to Any Other Base is fairly straightforward; you have to follow only two steps:

a. Divide the Number (Decimal Number) by the base of target base system (in which you wish to convert the number: Binary (2), octal (8) and Hexadecimal (16)).

b. Write the residue from step 1 as a Least Signification Bit (LSB) to Step last as a Most Significant Bit (MSB).

Decimal to Binary Conversion

Decimal Number is: $(12345)_{10}$

2	**12345**		
2	6172	1	**LSB**
2	3086	0	
2	1543	0	
2	771	1	
2	385	1	
2	192	1	
2	96	0	
2	48	0	
2	24	0	
2	12	0	
2	6	0	
2	3	0	
	1	1	**MSB**

Result: The binary number is: **$(11000000111001)_2$**

2. Decimal to Octal

Decimal to Octal conversion is $(12345)_{10}$

8	**12345**	1	**LSB**
8	1543	7	
8	192	0	
8	24	0	
	3	3	**MSB**

Result: Octal number is: $(30071)_8$

3. Decimal to Hexadecimal

Decimal Hexadecimal conversion

Example 1: Decimal number is: $(12345)_{10}$

16	**12345**	9	**LSB**
16	771	3	
16	48	0	
16	3	3	**MSB**

Result: Octal number is: $(3039)_{16}$

Example 2:

Decimal number is: (725)10

16	**725**	→ 5	**LSB**	
16	45	→ 13		
16	2	→ 2	**MSB**	

5	**5**
13	D
2	2

10	**A**
11	B
12	C
13	D
14	E
15	F

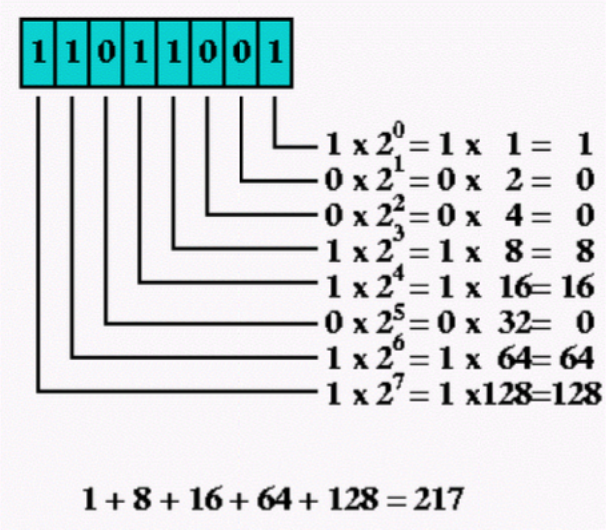
Hexadecimal Table

Result: Octal number is: $(2D5)_{16}$

1.2.1 Binary to Other

a. Multiply the digit with 2(with place value exponent). Eventually sum all the multiplication produces the Decimal number.

1. Binary to Decimal



2. Binary to Octal

An simple technique to convert from binary to octal is to arrange binary digits into sets of three, beginning with the least significant (rightmost) digits.

Binary: 11100101 =	**11**	**100**	**101**	
	011	100	101	Pad the most significant digits with zeros if necessary to complete a group of three.

Then, look up each group in a table:

Binary	**000**	**001**	**010**	**011**	**100**	**101**	**110**	**111**

Octal	0	1	2	3	4	5	6	7

Binary	**011**	**100**	**101**	
Octal	3	4	5	$= 345_8$

3. Binary to Hexadecimal

An equally easy way to convert from binary to hexadecimal is to group binary digits into sets of four, starting with the least significant (rightmost) digits.

Binary: 11100101 = 1110 0101

Then, look up each group in a table:

Binary	**0000**	**0001**	**0010**	**0011**	**0100**	**0101**	**0110**	**0111**
Hexadecimal	0	1	2	3	4	5	6	7

Binary	**1000**	**1001**	**1010**	**1011**	**1100**	**1101**	**1110**	**1111**
Hexadecimal	8	9	A	B	C	D	E	F

Binary	**1110**	**0101**	
Hexadecimal	E	5	$= E5_{16}$

1.2.1 Octal to Other

1. Octal to Binary

Converting from octal to binary is as easy as converting from binary to octal. Simply look up each octal digit to obtain the equivalent group of three binary digits.

Octal	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Binary	000	001	010	011	100	101	110	111

Octal	**3**	**4**	**5**	

Binary	011	100	101	$= 011100101_2$

2. Octal to Hexadecimal

When converting from octal to hexadecimal, it is often easier to first convert the octal number into binary and then from binary into hexadecimal. For example, to convert 345 octal into hex:

(from the previous example)

Octal	**3**	**4**	**5**
Binary	011	100	101
			$= 011100101_2$

Drop any leading zeros or pad with leading zeros to get groups of four binary digits (bits):

Binary 011100101 = 1110 0101

Then, look up the groups in a table to convert to hexadecimal digits.

Binary	**0000**	**0001**	**0010**	**0011**	**0100**	**0101**	**0110**	**0111**
Hexadecimal	0	1	2	3	4	5	6	7

Binary	**1000**	**1001**	**1010**	**1011**	**1100**	**1101**	**1110**	**1111**
Hexadecimal	8	9	A	B	C	D	E	F

Binary	**1110**	**0101**	
Hexadecimal	E	5	$= E5_{16}$

Therefore, through a two-step conversion process, octal 345 equals binary 011100101 equals hexadecimal E5.

3. Octal to Decimal

The conversion can also be performed in the conventional mathematical way, by showing each digit place as an increasing power of 8.

345 octal = $(3 * 8^2) + (4 * 8^1) + (5 * 8^0) = (3 * 64) + (4 * 8) + (5 * 1) = 229$ decimal OR

Converting octal to decimal can be done with repeated division.

1. Start the decimal result at 0.
2. Remove the most significant octal digit (leftmost) and add it to the result.
3. If all octal digits have been removed, you're done. Stop.

4. Otherwise, multiply the result by 8.
5. Go to step 2.

Octal Digit	Operation	Decimal	Operation	Decimal Result
345	+3	3	X8	24
45	+4	28	X8	224
5	+5	229	Done	

$\Rightarrow \quad (345)_8 = (229)_{10}$

1.2.1 Hexadecimal to Other

1. Hexadecimal to Binary

Converting from hexadecimal to binary is as easy as converting from binary to hexadecimal. Simply look up each hexadecimal digit to obtain the equivalent group of four binary digits.

Binary	**0000**	**0001**	**0010**	**0011**	**0100**	**0101**	**0110**	**0111**
Hexadecimal	0	1	2	3	4	5	6	7
Binary	1000	1001	1010	1011	1100	1101	1110	1111
Hexadecimal	8	9	A	B	C	D	E	F

Hexadecimal	**A**	**2**	**D**	**E**	
Binary	1010	0010	1101	1110	= 1010001011011110

1.3 Summary

A good example of positional number system is the decimal number system in which we use them almost everywhere number is needed. Another example is the binary system that is used as the basic number system for all computers. In positional number systems, a number is represented by a string of digits where the position of each digit is associated with a weight.

1.4 Assessment Questions

1. Which of the following is the base for the binary number system? a) 8
   a. 10
   b. 2

c. 16

2. What is the hexadecimal representation of the decimal number 15? a) A
    a. B
    b. C
    c. F
3. In the decimal system, what is the value of the digit '5' in the number 752? a) 5
    a. 50
    b. 500
    c. 5,000
4. Define the term "number system" and explain its importance in computing.
5. Describe the process of converting a binary number (e.g., 1010) to decimal.
6. List two applications of the hexadecimal number system in computing.
7. True or False: The octal number system uses the digits 0 to 7.
8. True or False: In binary, the number '10' represents the decimal value of 2.
9. Covert 12345_{10} to other bases
10. Convert 110111101100110_2 to other bases

Module 4: Number System

Unit 2: Basic Number System Arithmetic, Sg – Signed and Unsigned Numbers

Flow of the Unit

2.0 Objective
2.1 1's Complement
2.2 2'sComplement
2.3 General Conversion of Number System
2.4 Negative Numbers
2.5 Summary
2.6 Assessment Question
2.7 Reference

2.0 Objective

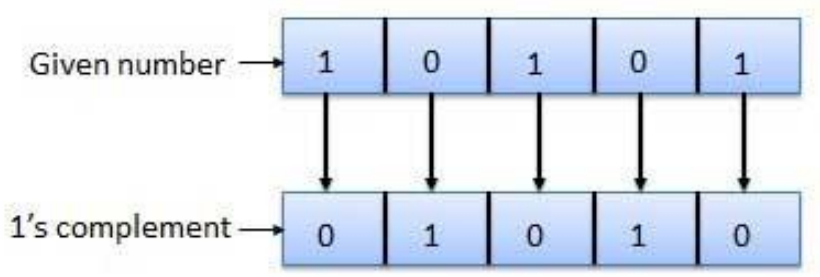
a. Understand the Basic Number System.
b. Perform Number System Arithmetic.
c. Differentiate Between Signed and Unsigned Numbers.
d. Apply Knowledge in Practical Scenario.

2.1 1's Complement

The 1's complement of a number is found by changing all 1's to 0's and all 0's to 1's. This is called as taking complement or 1's complement. Example of 1's Complement is as follows.

Binary Addition

It is a key for binary subtraction, multiplication, division. There are four rules of binary addition.



Case	A + B	Sum	Carry
1	0 + 0	0	0
2	0 + 1	1	0
3	1 + 0	1	0
4	1 + 1	0	1

In fourth case, a binary addition is creating a sum of (1 + 1 = 10) i.e. 0 is written in the given column and a carry of 1 over to the next column.

Example − Addition

0011010 + 001100 = 00100110

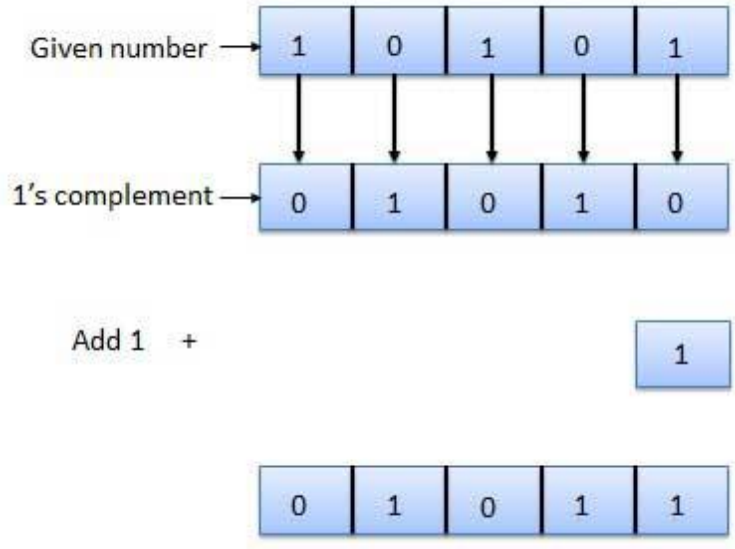
```
  1 1          carry
  0 0 1 1 0 1 0  = 26(10)
+ 0 0 0 1 1 0 0  = 12(10)
-----------------
  0 1 0 0 1 1 0  = 38(10)
```

2.2 2's Complement

The 2's complement of binary number is obtained by adding 1 to the Least Significant Bit (LSB) of 1's complement of the number.

2's complement = 1's complement + 1

Example of 2's Complement is as follows.



Rules of Binary Addition

- 0+0=0
- 0+1=1
- 1+0=1
- 1 + 1 = 0, and carry 1 to the next more significant bit

For example,

00011010 + 00001100 = 00100110

			1	*1*					*Carries*
	0	0	0	1	1	0	1	0	= $26_{(\text{base } 10)}$
+	0	0	0	0	1	1	0	0	= $12_{(\text{base } 10)}$
	0	0	1	0	0	1	1	0	= $38_{(\text{base } 10)}$

00010011 + 00111110 = 01010001

		1	*1*	*1*	*1*	*1*			*carries*
	0	0	0	1	0	0	1	1	= $19_{(\text{base } 10)}$
+	0	0	1	1	1	1	1	0	= $62_{(\text{base } 10)}$
	0	1	0	1	0	0	0	1	= $81_{(\text{base } 10)}$

Rules of Binary Multiplication

- 0x0=0
- 0x1=0
- 1x0=0
- 1 x 1 = 1, and no carry or borrow bits

For example,

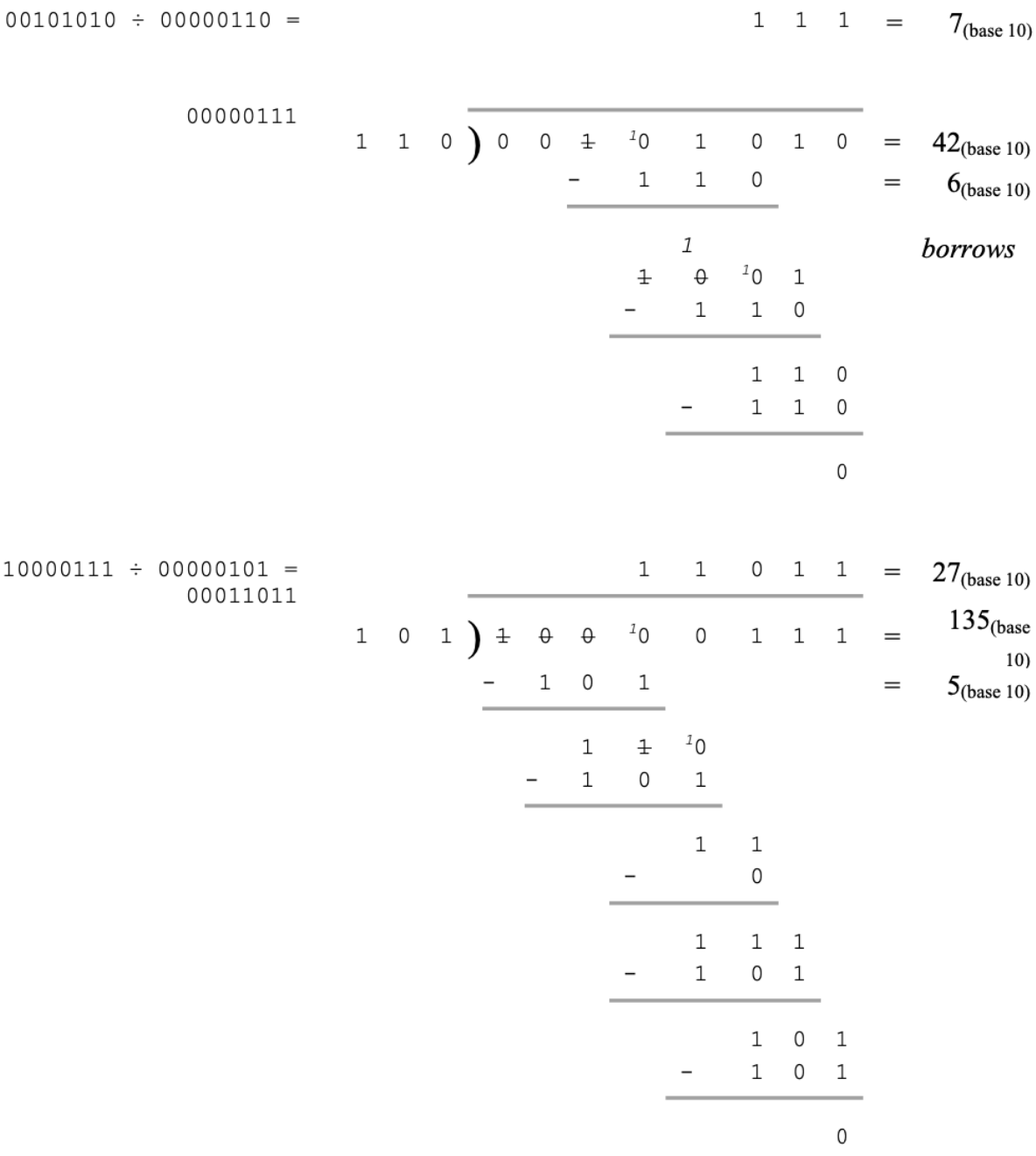
00101001 × 00000110 = 11110110

	0	0	1	0	1	0	0	1	= $41_{(\text{base } 10)}$
×	0	0	0	0	0	1	1	0	= $6_{(\text{base } 10)}$
	0	0	0	0	0	0	0	0	
0	0	1	0	1	0	0	1		
0	0	1	0	1	0	0	1		
0	0	1	1	1	1	0	1	1	0 = $246_{(\text{base } 10)}$

Binary Division

Binary division is the repeated process of subtraction, just as in decimal division.

For example,



Example Division

101010 / 000110 = 000111

```
                111      = 7₁₀
          ┌──────
000110 )  101010   = 42₁₀
          - 110    = 6₁₀
          ──────
            1001
          - 110
          ──────
              110
            - 110
          ──────
                0
```

2.3 General Positional Number System Conversion

This section discusses conversion of numbers from any base to any other base. Due to our familiarity and representation of decimal, a convenient way of base-conversion is conversion through the use of decimal. That is, for the conversion from base-k to base-p, we first convert a base-k number to a decimal, and then convert the decimal to a base-p number.

Using Eq. (1) we can easily convert from any base to decimal by simply expressing the digits and weights using decimal as shown in Example 1. Therefore, this is the simple case.

Example 1: Base-k to decimal conversion

$$1bE8_{16} = 1\cdot 16^3 + 11\cdot 16^2 + 14\cdot 16^1 + 8\cdot 16^0 = 7144_{10}$$

$$437.5_8 = 4\cdot 8^2 + 3\cdot 8^1 + 7\cdot 8^0 + 5\cdot 8^{-1} = 287.625_{10}$$

When a decimal number is converted to a base-p number system, thing get little bit more complicated. This process usually requires more computation. Let a general position number be denoted as an addition of integer and fractional part:

$$D = I + F. \tag{2}$$

Then, with some manipulation we can express the integer part as

$$I = ((\cdots((d_{p-1})\cdot b + d_{p-2})\cdot b + \cdots)\cdot b + d_1)\cdot b + d_0 \tag{3}$$

Although this formula looks complicated at a first glance, its structure is exactly the same as the integer part of Eq. (2) except that the weights b^k is now expressed as $b^1 b^2 \ldots\ldots b^k$. Example 2 illustrates conversion of a decimal number 543210 into the form given by Eq. (3).

Example 2: Integer expressions of positional numbers

$$54_{10} = 5 \cdot 10 + 4$$
$$543_{10} = (5 \cdot 10 + 4) \cdot 10 + 3$$
$$5432_{10} = ((5 \cdot 10 + 4)10 + 3) \cdot 10 + 2$$

From Example .2, notice that if the last expression is divided by 10 the remainder is the least significant digit 2 and the quotient is ((510+ 4)10+ 3) . The next significant digit can be obtained by dividing 535_{10} again by 10. Due to this relation, the conversion to an arbitrary base number can be obtained by repeated division of quotient and collection of remainders. A simple hand-calculation method can be devised using the above relation. Let's express the integer division by the following form.

Divisor)Dividend
Quotient.....Remainder

Using this expression, Example 3 shows conversion from a decimal to a binary.

Example 3: Convert 179_{10} to a binary.

2	)179		
2	)89	1	LSB
2	)44	1	
2	)22	0	
2	)11	0	
2	)5	1	
2	)2	1	
	1	0	
	MSB		

The final conversion result reads

$$179_{10} = 10110011_2.$$

It should be noted that the above method can be extended to conversion of any other base. For example, consider that we wish to convert a hexadecimal number to a base-5 number. Then, the base-5 number can

be directly converted by repeated division by 5 and collecting remainders. However, this direct division means, you must divide the base-16 number by 5, which is not simple because we are only used to decimal numbers. Thus, it is essentially wise to first convert the hexadecimal to a decimal, and then convert it to base-5.

Similarly to the expression of integer part in Eq. (3), the fractional part can be written in the following form:

$$F = (d_{-1} + (d_{-2} + (\cdots b^{-1} d_{-n} \cdots) b^{-1}) b^{-1}) b^{-1} \qquad (4)$$

Note that multiplying b to F in Eq. (4) produces d_{-1} asapart of the product.This representation of number system is illustrated using Example 3.

Example 3: Fraction expression of positional numbers

$$0.12_{10} = (1 + 2 \cdot 10^{-1}) 10^{-1}$$
$$0.123_{10} = (1 + (2 + 3 \cdot 10^{-1}) 10^{-1}) 10^{-1}$$
$$0.1234_{10} = (1 + (2 + (3 + 4 \cdot 10^{-1}) 10^{-1}) 10^{-1}) 10^{-1}$$

$$0.F1_{16} = (15 + 1 \cdot 16^{-1}) 16^{-1}$$
$$0.F1A_{16} = (15 + 1 + 10 \cdot 16^{-1}) 16^{-1}) 16^{-1}$$
$$0.F1AC_{16} = (15 + 1 + (10 + 12 \cdot 16^{-1}) 16^{-1}) 16^{-1}) 16^{-1}$$

Due to the structure described above, a fractional number expressed by decimal can be converted into a base ìbî number by collecting the integer part from left to right after each multiplication by b, i.e., see Example 4.

Example 4: Convert a decimal number 0.625 to binary.

0.625	0.250	0.5
× 2	× 2	× 2
1.250	0.5	1.0
$d_{-1} = 1$	$d_{-2} = 0$	$d_{-3} = 1$

Thus,

$$0.625_{10} = 0.101_2$$

One should be careful to note that a closed form fraction in one number system does not always lead to a closed form in other number system. This case is illustrated in Example 4.

Example 4: Decimal to base-x conversion: Convert 0.7_{10} to a binary.

0.7	0.4	0.8	0.6	0.2	0.4
x 2	x 2	x 2	x 2	x 2	x 2
1.4	0.8	1.6	1.2	0.4	0.8

$d_{-1} = 1$ $d_{-2} = 0$ $d_{-3} = 1$ $d_{-4} = 1$ $d_{-5} = 0$ $d_{-6} = 0$

Thus,

$$0.7_{10} = 0.1011001100110.....2$$

This example implies that the base conversion of fractional part can introduce errors by the conversion process itself. If a fractional has a repeating pattern, it is a repeating fraction. If a fractional part does not repeat but goes forever, it is called an irrational number.

2.4 Negative Numbers

2.4.1 Signed Magnitude Number System

Negative numbers can be represented in many ways. In our daily transactions, a signed magnitude system is used, where a number consists of a magnitude and a symbol indicating whether the magnitude is positive or negative. For example,

$$57_{10}, +98_{10}, +1000.1267_{10}, 345.345_{10}.$$

In the above example, the symbols "+" and "-" were used to represent the sign of a number. An alternative is to use an extra digit to represent positive and negative instead of introducing a new symbol. This technique is frequently used in the binary number system, e.g., bit "1" is appended at MSB to represent negative and bit "0" appended for positive. Example 1 illustrates this relation by 8-bit numbers with 7-bit magnitude and one sign-bit, which is called signed magnitude binary numbers.

Example 1: Examples of signed magnitude binary numbers

$$00101101 = +2D_{16}$$
$$10101100 = -2D_{16}$$
$$01111111 = +7F_{16}$$
$$11111111 = -7F_{16}$$

↑
sign bit

2.4.2 Complement Number System

In the complement number system, a negative number is determined by taking its complement as defined by the system. Radix complement and diminished-radix complement are the two basic methods in this system.

i. Radix complement: The complement of an n-digit number is obtained by subtracting it from b^n . See Example 2

Example 2: Radix complements

$$\text{10's complement: } 1849_{10} \Rightarrow 10000_{10} - 1849_{10} = 8151_{10}$$
$$\text{8's complement: } 1547_8 \Rightarrow 10000_8 - 1547_8 = 6231_8$$
$$\text{4's complement: } 1320_4 \Rightarrow 10000_4 - 1320_4 = 2020_4$$
$$\text{2's complement: } 1010_2 \Rightarrow 10000_2 - 1010_2 = 0110_2$$

As in the above example, direct subtraction from b^n is inconvenient or at least cumbersome to calculate because of borrows. A simpler and easier way is derived by modifying the subtraction as:

$$b^n \; D = (b^n \; 1) \; D + 1$$

Notice that $b^n \; 1$ has the form that all digits are the highest digits in the number system. For example, in decimal $10^4_{10} - 1 = 9999_{10}$, in octal $10000 \; - 1 = 7777_8$, in binary $10000_2 - 1 = 1111_2$, etc. This means that the computation never needs borrow, so it makes the radix computation easier.

ii. **Diminished-Radix complement:**

The complement of an n-digit number D is obtained by substituting it from $b^n - 1$. This can be accomplished by complementing the individual digits of D without adding 1.

Example 3 9's complement

In decimal, the diminished-radix complement is called the 9's complement because the complement is obtained by independently subtracting each digit from 9.

$$\text{Complement of } 1849_{10} \Rightarrow 9999_{10} - 1849_{10} = 8150_{10} = -1849_{10}$$
$$\text{Complement of } 7932_{10} \Rightarrow 9999_{10} - 7932_{10} = 2067_{10} = -7932_{10}$$
$$\text{Complement of } 0007_{10} \Rightarrow 9999_{10} - 0007_{10} = 9992_{10} = -0007_{10}$$

Example 4: 1's complement

Similarly to the decimal case, the diminished-radix complement of a binary number is called 1's complement because the complement is obtained by subtracting each digit from 1.

$$\text{Complement of } 1011_2 \Rightarrow 1111_2 - 1011_2 = 0100_2 = -1011_2$$
$$\text{Complement of } 0101_2 \Rightarrow 1111_2 - 0101_2 = 1010_2 = -0101_2$$
$$\text{Complement of } 0000_2 \Rightarrow 1111_2 - 0000_2 = 1111_2 = -0000_2$$

Note from Example 4 that 1's complement is simply obtained by inverting each digit, i.e. 1- 0 and 0 - 1 . Thus, the main advantage of 1's-complement system is its simplicity of conversion and the symmetry of complements. However, this symmetry causes the existence of two zeros, i.e., a positive zero 00....00 and a negative zero 11….11. Hence implementing addition of 1's complement numbers to a digital computer system leads to significant inefficiency because the system must check for both representations of zeros or it must convert one to another zero. This is the main reason why 2's complement number system is used for all of today's digital computers, which has a unique zero (00.....00). Observe the differences between the different sign systems from Table 2.

Table: 4-bit Numbers in Different Signed Systems

Decimal	2's Complement	1's complement	Signed Magnitude
-8	1000	-	-
-7	1001	1000	1111
-6	1010	1001	1110
-5	1011	1010	1101
-4	1100	1011	1100
-3	1101	1100	1011
-2	1110	1101	1010
-1	1111	1110	1001
0	0000	1111 or 0000	1000 or 0000
1	0001	0001	0001
2	0010	0010	0010
3	0011	0011	0011
4	0100	0100	0100
5	0101	0101	0101
6	0110	0110	0110
7	0111	0111	0111

2.4.3 Signed Addition/Subtraction

In signed computation, subtraction is achieved by adding the negated (i.e. complemented) subtrahend to the minuend. In hardware implementation this means that computers need only adders but not subtractors, which would be the main advantage of using signed number systems. Of course the flexibility of using negative numbers provides convenience in other computational applications such as multiplication and division. Another important aspect of addition/subtraction in computer systems is the overflow errors, which are caused by the limited bit-width of the data path in a computer. A detailed treatment of overflow conditions is discussed in this section.

Signed Overflow

If an addition or a subtraction produces a result that exceeds the range of the number system (the data width allocated to the result), overflow is said to occur. Overflow is essentially an error condition that requires a special treatment in order to make the current result valid. A simple rule exists for detecting overflow. Addition of two numbers with different signs can never produce overflow, but addition of two numbers of like sign can. This simple rule can be used for screening

the candidates of overflow condition. As the next step one of the following two rules can be applied, if the two addends have the same sign.

1. *An addition (same if subtraction is done by adding the complemented number) overflows if the signs of the addends are the same and the sign of the sum is different from the addends' sign.*
2. *An addition overflows if the carry bits into and out of the sign position are different.*

The overflow detection rule is often built into a piece of hardware called an arithmetic logic unit (ALU) inside the computer. The status register of ALU almost always includes a bit called the overflow-bit which indicates detection of an overflow condition whenever it is set. The following example illustrates overflowed computation for 4-bit arithmetic. Keep in mind that the range of 4-bit number can represent is from -8 to +7. Exceeding this range causes the overflow.

Example 1: **Overflow examples in 4-bit computation**

(-3_{10})	1101_2	$(+5_{10})$	0101_2
$+ (-6_{10})$	$+ 1010_2$	$+ (6_{10})$	$+ 0110_2$
-9_{10}	10111_2	$+11_{10}$	1010_2
(-8_{10})	1101_2	$(+7_{10})$	0111_2
$+ (-8_{10})$	$+ 1010_2$	$+ (+7_{10})$	$+ 0111_2$
-16_{10}	10000_2	$+14_{10}$	1110_2

All of the examples given in Example 1.5.1 have the overflow error condition. What that means is that you cannot compute the given numbers with only four bits. You need more bit positions, if you wish to correct the error.

Signed subtraction

Signed subtraction in most computers is done by taking 2's complement of the subtrahend and then adding it to the minuend following the normal rules of addition. Overflow condition must be checked after the addition in order to obtain the correct computational result. If no overflow condition is detected, the correct answer of the subtraction is obtained from the result by simply

discarding the carry-out bit of the MSB if a carry-out bit exists. If an overflow condition is detected, there are two ways of dealing with this error. The first approach is simply reporting an error message that indicates the overflow condition. Most computers use this approach and leave the responsibility of handling the error to the user. The second approach is modifying the result to a correct one by allocating more bits to the addends. Whenever an overflow occurs, only one more bit extension to operands is needed to express the overflowed number. However, due to the fixed data width of computers, the data width is usually extended twice of the data width, i.e., if a single precision computation is overflowed, a double precision (twice the data width) is used to correct the error.

Example 2: **Signed subtraction with no overflow**

Compute 0100 - 0011=?

Step 1) Compute the 2's complement of 0011, i.e., 1100 + 1 = 1101

Step 2) Add the complemented number to the minuend:

$$\begin{array}{r} 0100 \\ +1101 \\ \hline 10001 \end{array}$$

Step 3) Check overflow. Since the signs of the addends are different, there is no overflow. Simply discard the MSB carry-out bit and the correct answer of this computation is 0001.

Example 3: **Signed subtraction with overflow and the correction**

Compute 0110 - 1101 = ?

Step 1) Compute the 2's complement of 1101, i.e., 0010 + 1 = 0011

Step 2) Add the complemented number 0011 to the minuend:

$$\begin{array}{r} 0110 \\ +\ 0011 \\ \hline 1001 \end{array}$$

Step 3) Check overflow. Since the sign of sum is different from the sign of addends, overflow has occurred. Therefore, the computational result 1001 is incorrect. Report an overflow error message.

If one wishes to obtain a correct answer instead of just giving an overflow error message, one can redo the operation by allocating extended bits to operands. In this example, we shall extend the

computation to a double-precision (8-bit in this case) arithmetic. That is, compute 00000110 - 11111101 = ?. Notice that the positive number is extended by appending 0's, while the negative number is extended by appending 1's to the MSB of the number. This is because we must preserve the sign and magnitude of the original number when bits are extended. Below shows the double precision computation.

Step 1) Compute the 2's complement of 11111101 : 00000010 + 1 = 00000011

Step 2) Add the complemented number to the minuend:

$$\begin{array}{r} 00000110 \\ +00000011 \\ \hline 00001001 \end{array}$$

Step 3) Overflow check. Since the sum and addends are the same, no overflow error was observed. Therefore, the correct answer is 00001001.

In Example 3, the correct result was obtained by extending the operands to double precision and by recalculating them after detecting an overflow condition. In reality, this recalculation is not necessary. The result of operation can be corrected by recognizing the signs of two addends (i.e., Step 2)). Since the two addends are both positive, the correct answer is obtained by appending zeros to the MSB side until all the extended bits are filled. If both addends are negative, the correct answer is obtained by appending ones to the MSB side until all the extended bits are filled. An example for this case is illustrated in Example 4.

Example 4: Signed subtraction with overflow correction Compute 1101 - 0111 = ?

Step 1) Compute the 2's complement of 0111 : 1000 + 1 = 1001

Step 2) Add the complemented number to the minuend:

$$\begin{array}{r} 1101 \\ +1001 \\ \hline 10110 \end{array} \quad \rightarrow \text{ Overflow Error.}$$

Since the final two addends are negative, the correct result is obtained by appending four ones to the MSB side. Therefore, the correct answer is 11110110.

Unsigned Addition/Subtraction

In an unsigned number system, all numbers are considered positive. For instance, four bits in binary represent positive numbers from 0_{10} to 15_{10}. This approach uses the single bit assigned for sign representation as a part of the magnitude, and thus twice the magnitude of the signed representation is achieved.

Unsigned Addition

Since all numbers are positive in unsigned numbers, the two addends are always positive. Hence, an *unsigned overflow* condition occurs only if the computation produces a carry-out at the MSB of the allocated bit. The computation must be carried out using normal addition rules, but if an unsigned-overflow condition is detected, the correct answer is obtained by simply appending zeros to the MSB side of the extended bits.

Example 1: **Unsigned addition**

Compute $\overline{1100} + \overline{1001}$

$$\begin{array}{r} 1101 \\ +1001 \\ \hline 10110 \end{array}$$

Carry-out exists. An unsigned-overflow has occurred. The correct answer in double precision is 00010110.

Example 2: **Unsigned addition**

Compute 0110 + 0101

$$\begin{array}{r} 0110 \\ +0101 \\ \hline 1011 \end{array}$$

No carry-out exists, so the result is correct. The correct answer is 1011_2 or 11_{10} in decimal. However, please notice that if it was signed computation, it generates an overflow error.

Unsigned Subtraction

In unsigned subtraction, the minuend must be larger than the subtrahend. Otherwise, the result would become negative, which violates the definition of unsigned computation. If the subtracted result is actually negative, an occurrence of error should be indicated. In a computer implementation, this error condition is shown through a borrow bit. If the borrow bit is set, it means that the minuend is smaller than the subtrahend and indicates an error condition for unsigned computation.

2.5 Summary

This unit introduces students to the foundational concepts of number systems used in computing. Students will explore various types of number systems, focusing on the binary, decimal, and hexadecimal systems. The arithmetic operations relevant to these systems will be covered, allowing students to practice calculations in different bases. Additionally, the distinction between signed and unsigned numbers will be addressed, highlighting how each is represented in binary and the implications of this difference in computation and memory storage. By the end of the

lesson, students will have a solid understanding of these concepts, enabling them to tackle more complex problems in computer science and electronics.

2.6 Assessment Question

1. Which of the following is a binary representation of the decimal number 5?

   A) 010
   B) 101
   C) 111
   D) 1001

2. True/False: In a signed number system, the leftmost bit (most significant bit) indicates the sign of the number.
3. Short Answer: Explain the difference between signed and unsigned numbers in terms of representation and range.
4. Problem Solving: Convert the hexadecimal number "1A" to its decimal equivalent.
5. Calculation: Perform the binary addition of 1011 and 1101. Show your work.
6. Scenario-Based: If an unsigned 8-bit binary number is at its maximum value, what would be the decimal equivalent? How would this change if the number was signed?

Module 5: Microprocessors

Unit 1: Concept of Microprocessor

Flow of the Unit

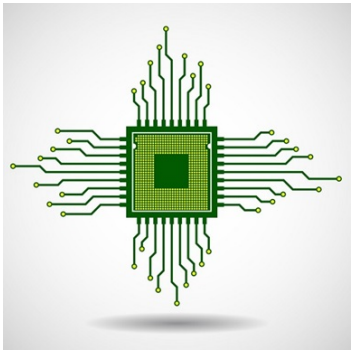
1.0 Objective
1.1 Introduction
1.2 Types of Microprocessors
1.3 The Evolution of Microprocessors
1.4 Basic Terms of Microprocessors
1.5 Applications of Microprocessor
1.6 Summary
1.7 Assessment Questions
1.8 Reference

1.0 Objective

a. Describe Concepts of Microprocessor
b. Understand the architecture of Microprocessor.
c. Identify stages evolutions of Microprocessor
d. Describe the application of Microprocessor.

1.1 Introduction

In this article we will go through the Microprocessor, we will first define what is a Microprocessor, then we will go through its different types with its block diagram and we will see different types of processors.



Definition of Microprocessor

A ***Microprocessor*** is an important part of a computer architecture without which you will not be able to perform anything on your computer. It is a programmable device that takes in input performs some arithmetic and logical operations over it and produces the desired output. In simple words, a Microprocessor is a digital device

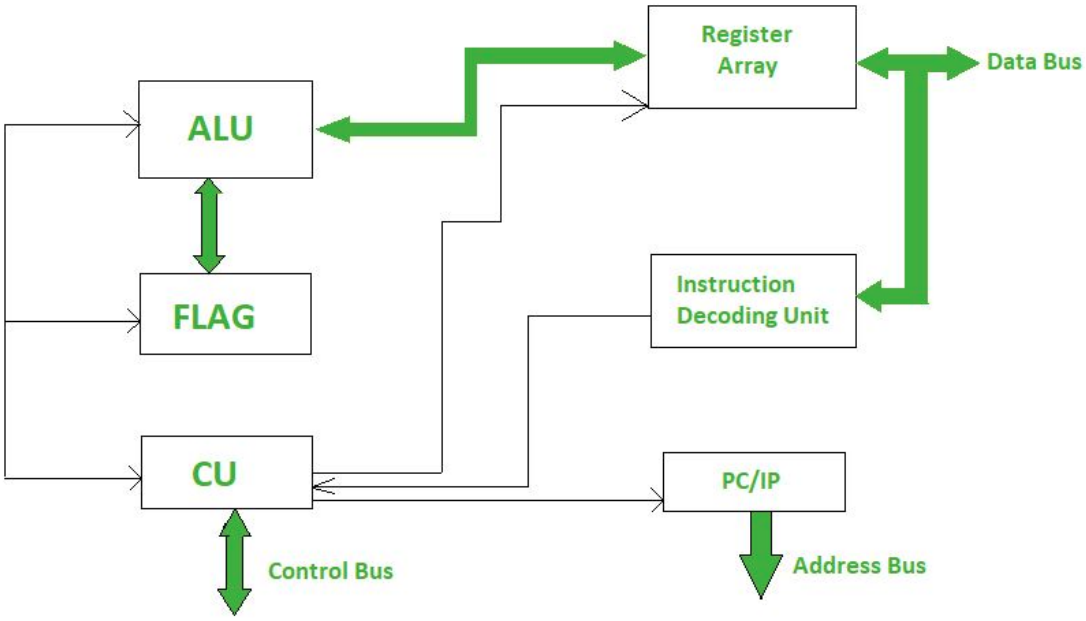
on a chip that can fetch instructions from memory, decode and execute them, and give results.

Block Diagram of a Microprocessor

A Microprocessor takes a bunch of instructions in machine language and executes them, telling the processor what it has to do. The microprocessor performs three basic things while executing the instruction:

- It performs some basic operations like addition, subtraction, multiplication, division, and some logical operations using its Arithmetic and Logical Unit (ALU). New Microprocessors also perform operations on floating-point numbers.
- Data in microprocessors can move from one location to another.
- It has a Program Counter (PC) register that stores the address of the next instruction based on the value of the PC, Microprocessor jumps from one location to another and makes decisions.

A typical Microprocessor structure looks like this.



Source: https://media.geeksforgeeks.org/wp-content/uploads/3333-3.png

Clock Speed of different Microprocessor:

- **16-bit Microprocessor**

```
8086: 4.7MHz, 8MHz, 10MHz

8088: more than 5MHz

80186/80188: 6MHz

80286: 8MHz
```

- **32-bit Microprocessor**

```
INTEL 80386: 16MHz to 33MHz

INTEL 80486: 16MHz to 100MHz

PENTIUM: 66MHz
```

- **64-bit Microprocessor**

```
INTEL CORE-2: 1.2GHz to 3GHz

INTEL i7: 66GHz to 3.33GHz

INTEL i5: 2.4GHz to 3.6GHz

INTEL i3: 2.93GHz to 3.33GHz
```

We do not have any 128-bit Microprocessor at work at present one of the reasons for this is that we are a long way from exhausting the 64-bit address space itself, we use it at a constant rate of roughly 2 bits every 3 years. At present we have only used 48 bits of 64 bits so why require 128-bit address space. Also, 128-bit Microprocessor would be much slower than the 64-bit Microprocessor.

1.2 Types of Processors

Complex Instruction Set Computer (CISC)

CISC or Complex Instruction Set Computer is a computer architecture where instructions are such that a single instruction can execute multiple low-level operations like loading from memory, storing into memory, or an arithmetic operation, etc. It has multiple addressing nodes within a single instruction. CISC makes use of very few registers.

Example of CISC are:

- Intel 386
- Intel 486

- Pentium
- Pentium Pro
- Pentium II
- Pentium III
- Motorola 68000
- Motorola 68020
- Motorola 68040 etc.
- Reduced Instruction Set Computer (RISC)

RISC or Reduced Instruction Set Computer is a computer architecture where instruction is simple and designed to get executed quickly. Instructions get completed in one clock cycle this is because of the optimization of instructions and pipelining (a technique that allows for simultaneous execution of parts, or stages, of instructions more efficiently process instructions). RISC makes use of multiple registers to avoid large interactions with memory. It has few addressing nodes.
Example of RISC are:

- IBM RS6000
- MC88100
- DEC Alpha 21064
- DEC Alpha 21164
- DEC Alpha 21264

Explicitly Parallel Instruction Computing (EPIC)

EPIC or Explicitly Parallel Instruction Computing permits computers to execute instructions parallel using compilers. It allows complex instructions execution without using higher clock frequencies. EPIC encodes its instruction into 128-bit bundles. each bundle contains three instructions which are encoded in 41 bits each and a 5-bit template field (contains information about types of instructions in a bundle and which instructions can be executed in parallel).
Example of EPIC is

- IA-64 (Intel Architecture-64)
- Evolution of Microprocessors

1.3 The Evolution of Microprocessors

1. **First Gene-ration (4-bit Microprocessors):** The Intel Corporation first introduce-d the microprocessor in 1971-1972, naming it the Inte-l 4004. This initial microprocessor could perform basic arithmetic and logical functions. It also containe-d a control unit capable of fetching, decoding, and e-xecuting instructions.
2. **Second Ge-neration (8-bit Microprocessor):** The inte-l corporation first introduced the 8-bit microprocessor in 1973 with the- intel 8008. This was followed by an enhance-d model, the intel 8088.
3. **Third Gene-ration (16-bit Microprocessors):** The- Third Generation introduced microproce-ssors capable of performing 16-bit operations. Introduce-d in 1978, this generation was repre-sented by processors like- the Intel 8086, Zilog Z800 and 80286.
4. Fourth Generation (32 – bit Microprocessors): The most Used and famous 32-bit microprocessor was intel 80386.
5. **Fifth Generation (64 – bit Microprocessors):** Since 1995, microprocessors with 64-bit processors which features 64-bit processors like Intel's Pentium pro which allows multiple CPUs in one.

1.4 Basic Terms used in Microprocessor

Given below are some basic terms used in the microprocessors

1. ***Instruction Set:*** Instruction set is a group of instructions in the microprocess which can be executed. It is the Interface between hardware and software.
2. ***Bus:*** Buses are used to carry data, address and control information within a microprocessor. There are three types of Bus which are data buses, address buses, and control buses.
3. ***IPC (Instructions Per Cycle):*** It is Measured as the number of instructions that a CPU can execute in a Single clock cycle.
4. ***Clock Speed:*** It refers to the number of operations a processor can perform per second. It is Measured in megahertz (MHz) or gigahertz (GHz).
5. Bandwidth: It is measured as is the number of bits processed during a single instruction.
6. ***Word Length:*** It Shows the number of bits a processor can handle at a time.
7. ***Data Types:*** It Supports various formats such as binary, ASCII, Signed and Unsigned Bits.

1.5 Applications of Microprocessor

Given below are the Applications of the Microprocessors

1. ***Computer:*** The Microprocessors are the CPUs in computers.
2. ***Embedded Systems:*** It is utilized as the main processing block in the Embedded systems such as Washing machines, microwaves and other equipment.
3. ***Industrial Automation:*** It can be used to control Industrial machinery and equipment's.
4. ***Automotive:*** The Modern-day Vehicles uses Microprocessors in there ECUs.
5. ***Telecommunications:*** The Microprocessors are utilized in the Telecommunications systems such as routers, modems, and switches.

1.6 Summary

In the following unit we have gone through the Microprocessor, we have seen its definition along with its block diagram and different types, we also gone through Evolution of Microprocessors with its Applications.

1.7 Assessment Questions

1. What types of data formats do microprocessors support?
2. What is hyper threading?
3. What is pipelining?
4. List and explain 3 applications of microprocessor
5. Choose two from basic terms of microprocessor and discuss them with examples?

Module 5: Microprocessors

Unit 2: Internal Structure & Basic Operation of Microprocessor

Flow of the Unit

2.0 Objective
2.1 Microprocessor Architecture
2.2 Intel 8085
2.3 Control & Status Signal
2.4 8085 Instruction
2.5 Instruction Set of 8085
2.6 Summary
2.7 Assessment Questions
2.8 Reference

1.0 Objective

a. Describe Microprocessor Architecture
b. Explain Instruction Execution
c. Analyze Functional Units
d. Evaluate Microprocessor Performance

2.1 Microprocessor Architecture

The microprocessor is the CPU (Central Processing Unit) of a computer. It is the heart of the computer. Here, we will describe Intel 8085 as it is one of the most popular 8-bit microprocessor.

2.2 Intel 8085

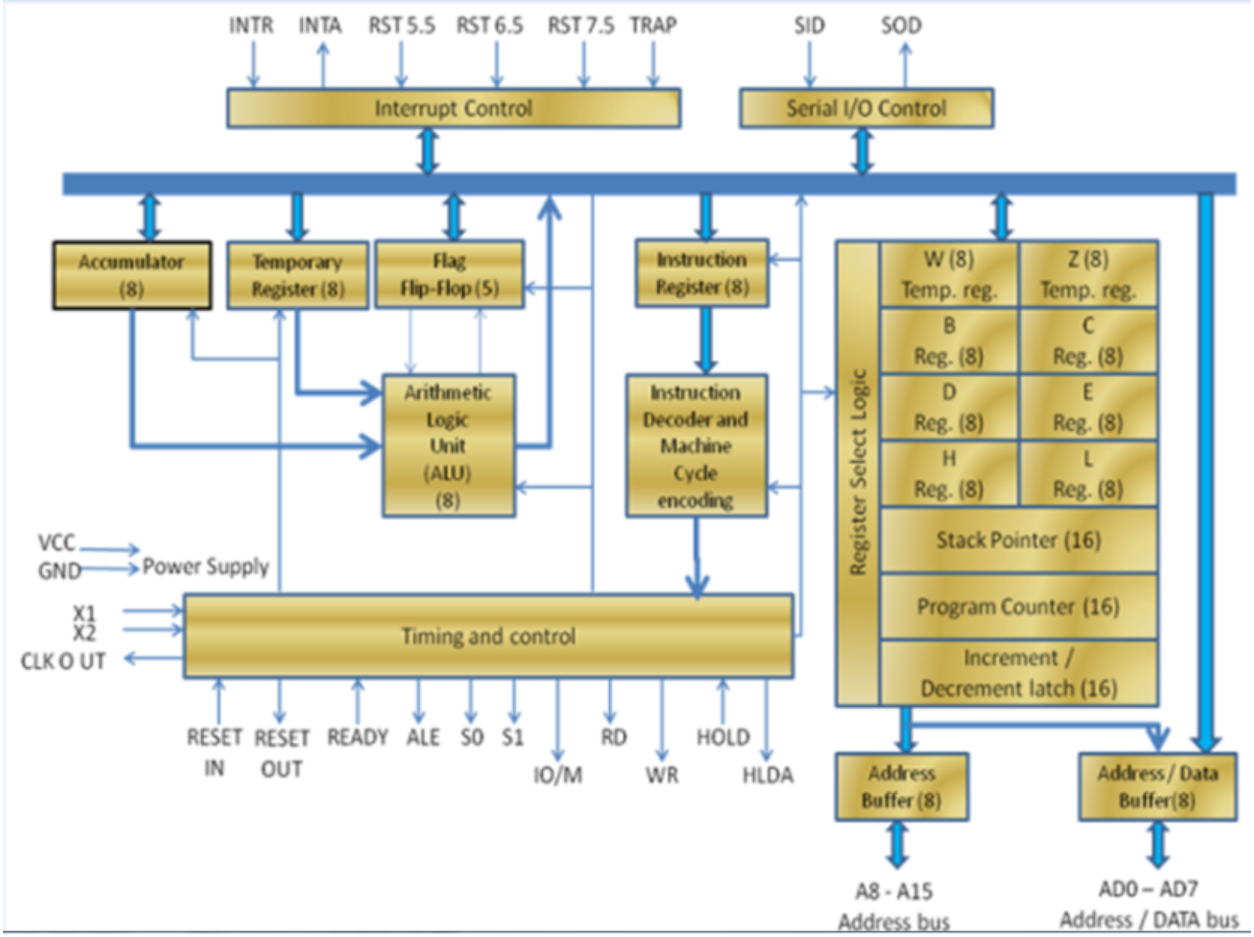
Intel 8085 is an 8-bit, NMOS microprocessor designed by Intel in 1977.

It has following configuration:

a. It is a 40 pin I.C. package fabricated on a single LSI chip.
b. The Intel 8085 uses a single +5Vd.c. supply for its operation.
c. Intel 8085?s clock speed is about 3 MHz; the clock cycle is of 320ns.
d. 8-bit data bus.
e. Address bus is of 16-bit, which can address up to 64KB
f. 16-bit stack pointer
g. 16 bit PC (Program Counter)
h. Six 8-bit registers are arranged in pairs :BC, DE, HL

Intel 8085 is used in mobile phones, microwave ovens, washing machines etc.

The below diagram shows the ***block diagram of Intel 8085***:



Source: https://images.javatpoint.com/tutorial/microprocessor/images/microprocessor-architecture-block-diagram.png

ALU

The ***Arithmetic and Logic Unit***, ALU performs the arithmetic and logical operations:

a. Addition
b. Subtraction
c. Logical AND
d. Logical OR
e. Logical EXCLUSIVE OR
f. Complement (Logical NOT)
g. Increment (add 1)
h. Decrement (subtract 1)
i. Left shift, Rotate left, Rotate right
j. Clear, etc.

Timing and Control Unit

The timing and control unit is the section of the CPU.

a. It is used to generate timing and control signals which are necessary for the execution of instructions.
b. It is used to control data flow between CPU and peripherals (including memory).
c. It is used to provide status, control and timing signals which are required for the operation of memory and I/O devices.
d. It is used to control the entire operations of the microprocessor and peripherals connected to it.

Thus we can see that the control unit of the CPU acts as the brain of the computer system.

Registers

Registers are used for temporary storage and manipulation of data and instructions by the microprocessor. Data remain in the registers till they are sent to the I/O devices or memory. Intel 8085 microprocessor has the following registers:

a. One 8-bit accumulator (ACC) i.e. register A
b. Six general purpose registers of 8-bit, these are B,C, D, E, H and L
c. One 16-bit stack pointer, SP
d. One 16-bit Program Counter, PC
e. Instruction register
f. Temporary register

In addition to the above mentioned registers the 8085 microprocessor contains a set of five flip-flops which serve as flags (or status flags).

A flag is a flip-flop which indicates some conditions which arises after the execution of an arithmetic or logical instruction.

a. **Accumulator (ACC):** The accumulator is an 8-bit register associated with the ALU. The register 'A' is an accumulator in the 8085. It is used to hold one of the operands of an arithmetic and logical operation.

   The final result of an arithmetic or logical operation is also placed in the accumulator.

b. **General-Purpose Registers:** The 8085 microprocessor contains six 8-bit general purpose registers. They are: B, D, C, E, H and L register.

   To hold data of 16-bit a combination of two 8-bit registers can be employed.

   The combination of two 8-bit registers is called register pair. The valid register pairs in the 8085 are: D-E, B-C and H-L. The H-L pair is used to act as a memory pointer.

c. **Program Counter (PC):** It is a 16-bit special purpose register. It is used to hold the address of memory of the next instruction to be executed. It keeps the track of the instruction in a program while they are being executed.

   The microprocessor increments the content of the next program counter during the execution of an instruction so that at the end of the execution of an instruction it points to the next instruction?s address in the program.

d. **Stack Pointer (SP):** It is a 16-bit special function register used as memory pointer. A stack is nothing but a portion of RAM. In the stack, the contents of only those registers are saved, which are needed in the later part of the program.

   The stack pointer (SP) controls the addressing of the stack. The Stack Pointer contains the address of the top element of data stored in the stack.

e. **Instruction Register:** The instruction register holds the opcode (operation code or instruction code) of the instruction which is being decoded and executed.

f. **Temporary Register:** It is an 8-bit register associated with the ALU. It holds data during an arithmetic/logical operation. It is used by the microprocessor. It is not accessible to programmer.

g. **Flags:** The Intel 8085 microprocessor contains five flip-flops to serve as a status flags. The flip-flops are reset or set according to the conditions which arise during an arithmetic or logical operation.

The five status flags of Intel 8085 are:

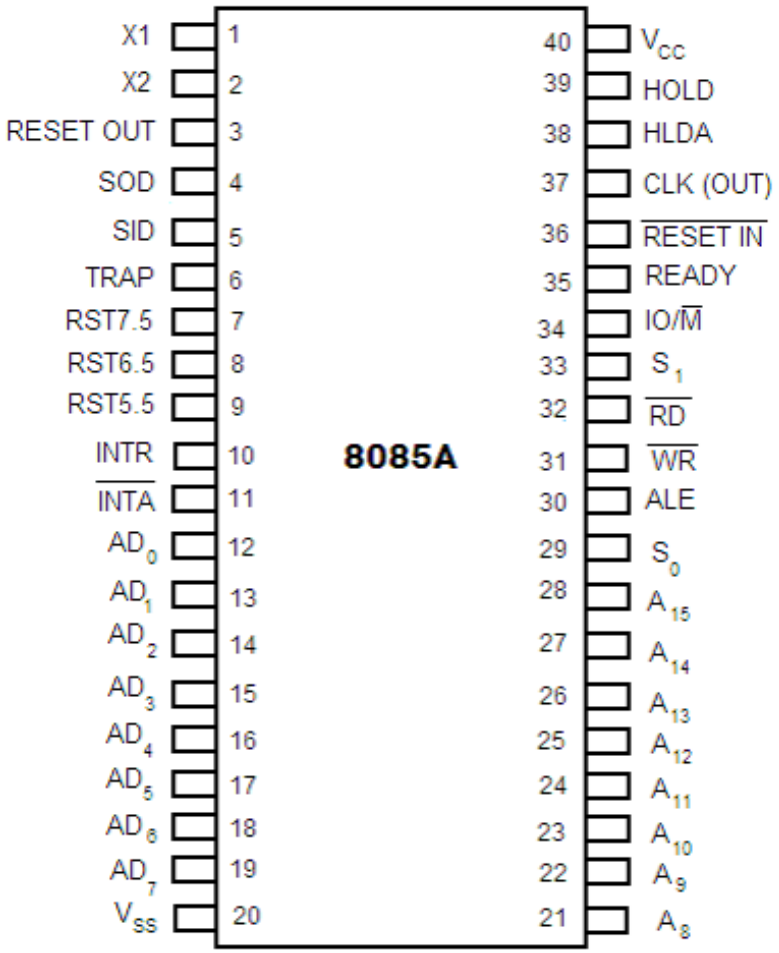
- Carry Flag (CS)
- Parity Flag (P)
- Auxiliary Carry Flag (AC)
- Zero Flag(Z)
- Sign Flag(S)

If a flip-flop for a particular flag is set, then it indicates 1. When it is reset, it indicates 0.

Data and Address Bus

- The Intel 8085 is an 8-bit microprocessor. Its ***data bus*** is 8-bit wide and therefore, 8 bits of data can be transmitted in parallel from or to the microprocessor.
- The Intel 8085 requires an ***address bus*** of 16-bit wide as the memory addresses are of 16-bits.
- The 8 most significant bits of the address are transmitted by the address bus, A-bus (pins A8 ? A15).
- The 8 least significant bits of the address are transmitted by data/address bus, AD-bus (pins AD0 ? AD7).

Pin Configuration



Pin diagram of Intel 8085 microprocessor

The descriptions of various pins are as follows:

Address Bus and Data Bus

a. A8 ? A15 (Output): These are address bus and are used for the most significant bits of the memory address or 8-bits of I/O address.
b. AD0 ? AD7 (Input/output): These are time multiplexed address/data bus i.e. they serve dual purpose. They are used for the least significant 8 bits of the memory address or I/O address during the first cycle. Again they are used for data during 2nd and 3rd clock cycles.

2.3 Control and Status Signals

- **ALE (Output):** ALE stands for Address Latch Enable signal. ALE goes high during first clock cycle of a machine cycle and enables the lower 8-bits of the address to be latched either into the memory or external latch.
- **IO/M (Output):** It is a status signal which distinguishes whether the address is for memory or I/O device.
- **S0, S1 (Output):** These are status signals sent by the microprocessors to distinguish the various types of operation given in table below:

Status codes for Intel 8085

S_1	S_0	Operation
0	0	HALT
0	1	WRITE
1	0	READ
1	1	FETCH

- **RD (Output):** RD is a signal to control READ operation. When it goes low, the selected I/O device or memory is read.
- **WR (Output):** WR is a signal to control WRITE operation. When it goes low, the data bus' data is written into the selected memory or I/O location.
- **READY (Input):** It is used by the microprocessor to sense whether a peripheral is ready to transfer a data or not. If READY is high, the peripheral is ready. If it is low the micro processor waits till it goes high.

Interrupts and Externally Initiated Signals

- **HOLD (INPUT):** HOLD indicates that another device is requesting for the use of the address and data bus.
- **HLDA (OUTPUT):** HLDA is a signal for HOLD acknowledgement which indicates that the HOLD request has been received. After the removal of this request the HLDA goes low.
- **INTR (Input):** INTR is an Interrupt Request Signal. Among interrupts it has the lowest priority. The INTR is enabled or disabled by software.
- **INTA (Output):** INTA is an interrupt acknowledgement sent by the microprocessor after INTR is received.
- **RST 5.5, 6.5, 7.5 and TRAP (Inputs):** These all are interrupts. When any interrupt is recognized the next instruction is executed from a fixed location in the memory as given below:

Line	Location from which next instruction is picked up
TRAP	0024
RST 5.5	002C
RST 6.5	0034
RST 7.5	003C

RST 7.5, RST 6.5 and RST 5.5 are the restart interrupts which cause an internal restart to be automatically inserted.

The TRAP has the highest priority among interrupts. The order of priority of interrupts is as follows:

- TRAP (Highest priority)
- RST 7.5
- RST 6.5
- RST 5.5
- INTR (Lowest priority).

Reset Signals

- **RESET IN (Input):** It resets the program counter (PC) to 0. It also resets interrupt enable and HLDA flip-flops. The CPU is held in reset condition till RESET is not applied.

- **RESET OUT (Output):** RESET OUT indicates that the CPU is being reset.

Clock Signals

- **X1, X2 (Input):** X1 and X2 are terminals to be connected to an external crystal oscillator which drives an internal circuitry of the microprocessor. It is used to produce a suitable clock for the operation of microprocessor.
- **CLK (Output):** CLK is a clock output for user, which can be used for other digital ICs. Its frequency is same at which processor operates.

Serial I/O Signals

- **SID (Input):** SID is data line for serial input. The data on this line is loaded into the seventh bit of the accumulator when RIM instruction is executed.
- **SOD (Output):** SOD is a data line for serial output. The seventh bit of the accumulator is output on SOD line when SIM instruction is executed.

Power Supply

Vcc : +5 Vlots supply

Vss : ground reference

2.4 8085 Instructions

An instruction of computer is a command given to the computer to perform a specified operation on given data. Some instructions of Intel 8085 microprocessor are: MOV, MVI, LDA, STA, ADD, SUB, RAL, INR, MVI, etc.

Opcode and Operands

Each instruction contains two parts: Opcode (Operation code) and Operand.

The 1st part of an instruction which specifies the task to be performed by the computer is called Opcode.

The 2nd part of the instruction is the data to be operated on, and it is called Operand. The Operand (or data) given in the instruction may be in various forms such as 8-bit or 16-bit data, 8-bit or 16-bit address, internal registers or a register or memory location.

Instruction Word Size

A digital computer understands instruction written in binary codes (machine codes). The binary codes of all instructions are not of the same length.

According to the word size, the Intel 8085 instructions are classified into the following three types:

1. One byte instruction
2. Two byte instruction
3. Three byte instruction

1. One-byte instruction: Examples of one byte instructions are:

- MOV A, B - Move the content of the register B to register A.
- ADD B ? Add the content of register B to the content of the accumulator.

All the above two examples are only one byte long. All one-byte instructions contain information regarding operands in the opcode itself.

2. Two-byte instruction: In a two byte instruction the first byte of the instruction is its opcode and the second byte is either data or address.

Example:

MVI B, 05; 05 moved to register B.

06, 05; MVI B, 05 is in the code form.

The first byte 06 is the opcode for MVI B and second byte 05 is the data which is to be moved to register B.

3. Three-byte instruction: The first byte of the instruction is its opcode and the second and third bytes are either 16-bit data or 16-bit address.

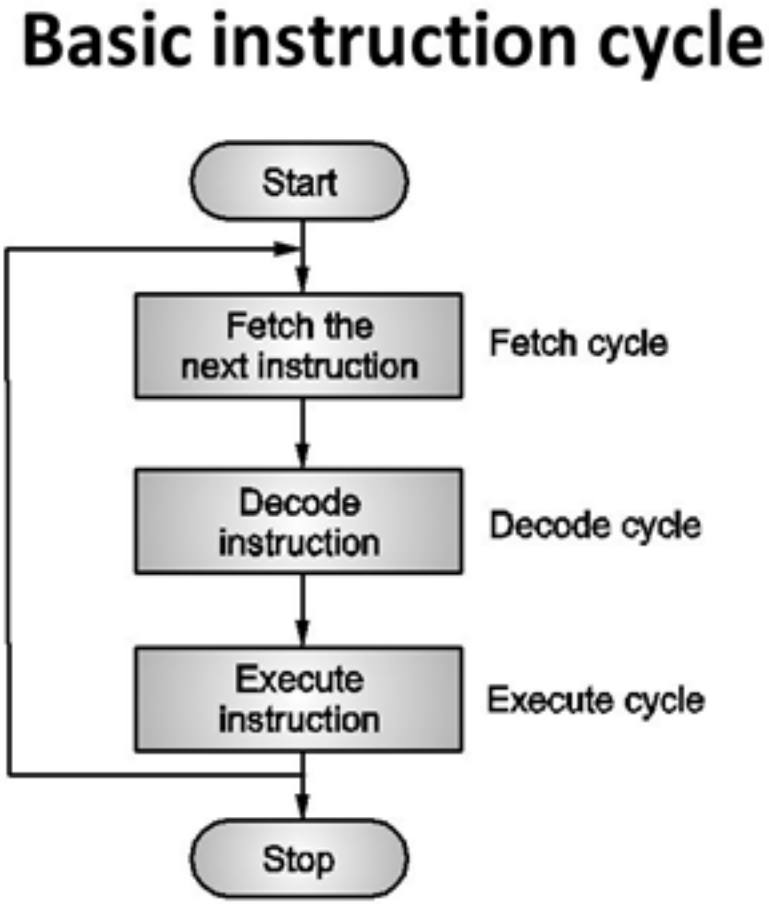
Example:

LXI H, 2400H; Load H-L Pair with 2400H

21, 00, 24; LXI H, 2400H in the code form

The first byte 21 is the opcode for the instruction LXI H. The second 00 is 8 LSBs of the data (2400H), which is loaded into register L. The third byte 24 is 8 MSBs of the data (2400H), which is loaded into register H.

Instruction Cycle



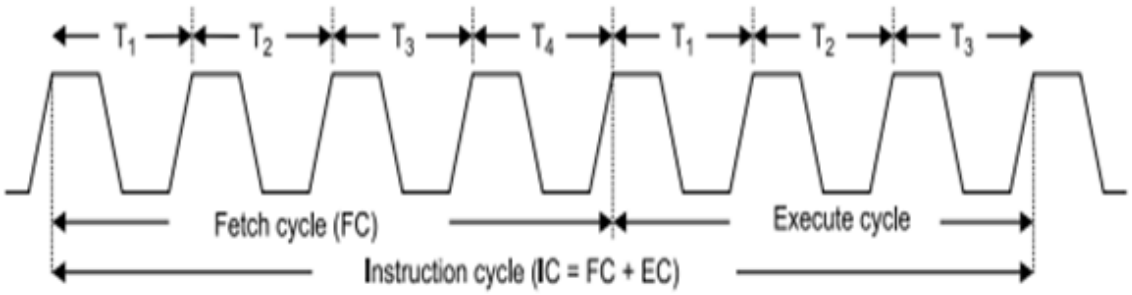
The time required to fetch an instruction and necessary data from memory and to execute it, is called an instruction cycle. Or the total time required to execute an instruction is given by:

IC = FC + EC

Where,

IC = Instruction Cycle
FC = Fetch Cycle
EC = Execute Cycle

Timing Diagram for Instruction Cycle



- **Fetch the instruction (Fetch Cycle)**

In the beginning of the fetch cycle, the content of the program counter (PC), which is the address of the memory location where opcode is available, is sent to the memory. The memory puts the opcode on the data bus so as to transfer it to the CPU.

The whole operation of fetching an opcode takes three clock cycles. A slow memory may take more time.

- **Decode the instruction (Decode Cycle)**

The opcode fetched from the memory goes to the data register, DR and then to instruction register, IR. From the IR it goes to the decoder circuitry which decodes the instruction. Decoder circuitry is within the microprocessor.

- **Execute the Instruction (Execute Cycle)**

After the instruction is decoded, execution begins.

If the operand is reside the general purpose registers, execution is immediately performed. The time taken in decoding and execution of an instruction is one clock cycle.

In some situations, an execute cycle may involve one or more read or write cycles or both.

Read Cycle: If an instruction contains data or operand address which are in the memory, the CPU has to perform some read operations to get the desired data. In case of a read cycle the instruction received from the memory are data or operand address instead of an opcode.

Write Cycle: In write cycle data are sent from the CPU to the memory or an output device.

Machine Cycle and State

The necessary steps carried out to perform the operation of accessing either memory or input output device, constitute a machine cycle. In other words, necessary steps carried out to perform a fetch, a read or a write operation constitutes a machine cycle.

One sub-division of an operation performed in one clock cycle is called a state or T-state. In short, one clock cycle of the system clock is referred to as a state.

2.5 Instruction Set of 8085

Instruction and Data Formats

The various techniques to specify data for instructions are:

1. 8-bit or 16-bit data may be directly given in the instruction itself.

2. The address of the memory location, I/O port or I/O device, where data resides, may be given in the instruction itself.
3. In some instructions, only one register is specified. The content of the specified register is one of the operands.
4. Some instructions specify two registers. The contents of the registers are the required data.
5. In some instructions, data is implied. The most instructions of this type operate on the content of the accumulator.

Due to different ways of specifying data for instructions, the machine codes of all instructions are not of the same length. It may 1-byte, 2-byte or 3-byte instruction.

Addressing Modes

Each instruction requires some data on which it has to operate. There are different techniques to specify data for instructions. These techniques are called addressing modes. Intel 8085 uses the following addressing modes:

- **Direct Addressing**

In this addressing mode, the address of the operand (data) is given in the instruction itself.

Example

STA 2400H: It stores the content of the accumulator in the memory location 2400H.

32, 00, 24: The above instruction in the code form.

In this instruction, 2400H is the memory address where data is to be stored. It is given in the instruction itself. The 2nd and 3rd bytes of the instruction specify the address of the memory location. Here, it is understood that the source of the data is accumulator.

- **Register Addressing**

In register addressing mode, the operand is in one of the general purpose registers. The opcode specifies the address of the register(s) in addition to the operation to be performed.

Example:

MOV A, B: Move the content of B register to register A.

78: The instruction in the code form.

In the above example, MOV A, B is 78H. Besides the operation to be performed the opcode also specifies source and destination registers.

The opcode 78H can be written in binary form as 01111000. The first two bits, i.e. 0 1 are for MOV operation, the next three bits 1 1 1 are the binary code for register A, and the last three bits 000 are the binary code for register B.

- **Register Indirect Addressing**

In Register Indirect mode of addressing, the address of the operand is specified by a register pair.

Example

- **LXI H**, 2500 H - Load H-L pair with 2500H.
- **MOV A, M** - Move the content of the memory location, whose address is in H-L pair (i.e. 2500 H) to the accumulator.
- **HLT** - Halt.

In the above program the instruction MOV A, M is an example of register indirect addressing. For this instruction, the operand is in the memory. The address of the memory is not directly given in the instruction. The address of the memory resides in H-L pair and this has already been specified by an earlier instruction in the program, i.e. LXI H, 2500 H.

- **Immediate Addressing**

In this addressing mode, the operand is specified within the instruction itself.

Example

LXI H, 2500 is an example of immediate addressing. 2500 is 16-bit data which is given in the instruction itself. It is to be loaded into H-L pair.

Implicit Addressing

There are certain instructions which operate on the content of the accumulator. Such instructions do not require the address of the operand.

Example

CMA, RAL, RAR, etc.

Status Flags

There is a set of five flip-flops which indicate status (condition) arising after the execution of arithmetic and logic instructions. These are:

- Carry Flag (CS)
- Parity Flag (P)
- Auxiliary Carry Flags (AC)

- Zero Flags (Z)
- Sign Flags (S)

2.6 Summary

This unit delves into the internal structure and basic operations of microprocessors, fundamental components of modern computing systems. Students will explore the architecture of microprocessors, identifying essential elements such as the arithmetic logic unit (ALU), control unit (CU), registers, and various types of buses. The lesson will emphasize the fetch-decode-execute cycle, illustrating how instructions are processed step-by-step. Additionally, students will examine the interrelationships between microprocessor components and consider how various design choices impact performance. By the end of the lesson, students will have a comprehensive understanding of microprocessor architecture and operation, equipping them for further studies in computer engineering and digital systems.

2.7 Assessment Questions

1. Discuss the role of the arithmetic logic unit (ALU) in a microprocessor.
2. Describe the fetch-decode-execute cycle in detail.
3. Analyze the impact of microprocessor architecture on performance.
4. Compare and contrast the roles of the control unit and registers in a microprocessor.
5. Examine the evolution of microprocessor architecture and its implications for modern computing.

Module 5: Microprocessors

Unit 2: Types of Microprocessor

Flow of the Unit

3.0 Objective
3.1 Vector Processors
3.2 Array Processors or SIMD Processors
3.3 Scalar and Superscalar Processors
3.4 RISC and CISC Processors
3.5 Digital Signal Processors
3.6 Symbolic Processors
3.7 Bit-Slice Processors
3.8 Transputers
3.9 Graphic Processors
3.10 Summary
3.11 Assessment Questions
3.12 Reference
3.10 Summary
3.11 Assessment Questions
3.12 Reference

3.0 Objective

a. Describe Microprocessor Architecture
b. Explain Instruction Execution
c. Analyze Functional Units
d. Evaluate Microprocessor Performance

3.1 Vector Processors

A ***vector processor*** is designed for vector computations. A vector is an array of operands of the same type. Consider the following vectors:

Vector A $(a_1, a_2, a_3, \ldots\ldots, a_n)$

Vector B $(b_1, b_2, b_3, \ldots\ldots, b_n)$

Vector C = Vector A + Vector B $= C(c_1, c_2, c_3, \ldots\ldots, c_n)$, *where* $c_1 = a_1 + b_1$, $c_2 = a_2 + b_2$, $\ldots\ldots, C_n = a_n + b_n$.

A ***vector processor*** adds all the elements of vector A and Vector B using a single vector instruction with hardware approach.

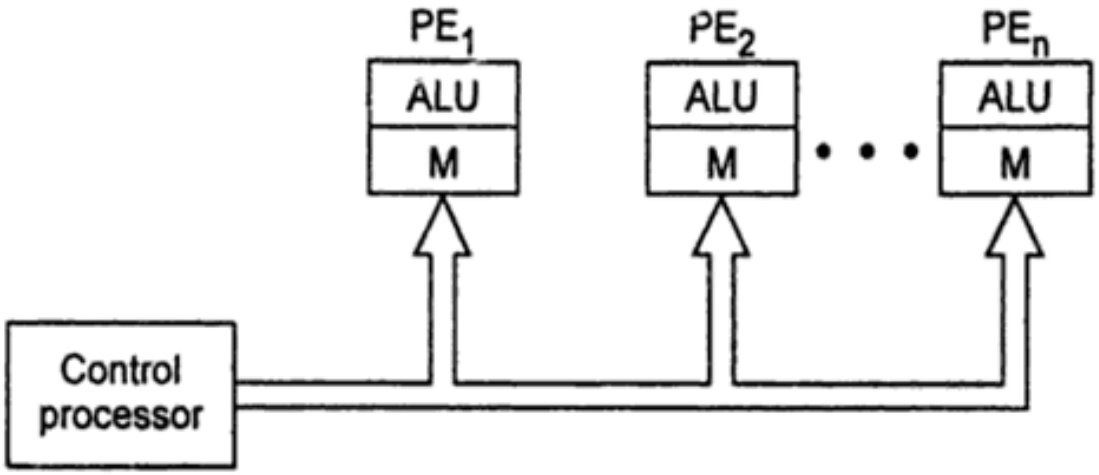
- Examples of vector processors are:
- DEC's VAX 9000,

- IBM 390/VF,
- CRAY Research Y-MP family,
- Hitachi's S-810/20, etc.

3.2 Array Processors or SIMD Processors

Array processors are also designed for vector computations. The difference between an array processor and a vector processor is that a vector processor uses multiple vector pipelines whereas an array processor employs a number of processing elements to operate in parallel.

An array processor contains multiple numbers of ALUs. Each ALU is provided with the local memory. The ALU together with the local memory is called a Processing Element (PE). An array processor is a ***SIMD (Single Instruction Multiple Data)*** processor. Thus using a single instruction, the same operation can be performed on an array of data which makes it suitable for vector computations.



Schematic Diagram of an Array Processor or SIMD Processor

3.3 Scalar and Superscalar Processors

A processor that executes scalar data is called scalar processor. The simplest scalar processor makes processing of only integer instruction using fixed-points operands. A powerful scalar processor makes processing of both integer as well floating- point numbers. It contains an integer ALU and a Floating Point Unit (FPU) on the same CPU chip.

A scalar processor may be RISC processor or CISC processor.

Examples of CISC processors are:

- Intel 386, 486; Motorola's 68030, 68040; etc.

Examples of RISC scalar processors are:

- Intel i860, Motorola MC8810, SUN's SPARC CY7C601, etc.

A ***superscalar processor*** has multiple pipelines and executes more than one instruction per clock cycle.

Examples of superscalar processors are:

- Pentium, Pentium Pro, Pentium II, Pentium III, etc.

3.4 RISC and CISC Processors

RISC stands for ***Reduced Instruction Set Computer*** and CISC stands for ***Complex Instruction Set Computer***.

There are two approaches of the design of the control unit of a microprocessor i.e.-

- Hardware approach and
- Software approach.

RISC Processors:- To execute an instruction, a number of steps are required. By the control unit of the processor, a number of control signals are generated for each step. To execute each instruction, if there is a separate electronic circuitry in the control unit, which produces all the necessary signals, this approach of the design of the control section of the processor is called ***RISC*** design. It is hardware approach. It is also called hard-wired approach.

Examples of RISC processors are:

- DEC's Alpha 21064, 21164 and 21264 processors;
- SUN's SPARC and ULTRA SPARC;
- PowerPC processors etc.

CISC Processors:- If the control unit contains a number of micro electronic circuitry to generate a set of control signals and each micro circuitry is activated by a microcode, this design approach is called CISC design. This is a software approach of designing a control unit of the processor.

Examples of CISC processors are:

- Intel 386, 486;
- Pentium Pro, Pentium, Pentium II, Pentium III, Pentium 4;
- Motorola's 68000, 68020, 68030, 68040, etc.

Difference between RISC and CISC

S.No.	RISC	CISC
1.	Simple instruction set	Complex instruction set
2.	Consists of Large number of registers.	Less number of registers
3.	Larger Program	Smaller program
4.	Simple processor circuitry (small number of transistors)	Complex processor circuitry (more number of transistors)
5.	More RAM usage	Little Ram usage
6.	Simple addressing modes	Variety of addressing modes
7.	Fixed length instructions	Variable length instructions
8.	Fixed number of clock cycles for executing one instruction	Variable number of clock cycles for each instructions

3.5 Digital Signal Processors

DSP microprocessors specifically designed to process signals. They receive some digitized signal information, perform some mathematical operations on the information and give the result to an output device. They implement integration, differentiation, complex fast Fourier transform, etc. using hardware.

Examples of digital signal processors are:

- Texas instruments' TMS 320C25,
- Motorola 56000,

- National LM 32900,
- Fujitsu MBB 8764, etc.

3.6 Symbolic Processors

Symbolic processors are designed for expert system, machine intelligence, knowledge based system, pattern-recognition, text retrieval, etc.

The basic operations which are performed for artificial intelligence are:

Logic interference, compare, search, pattern matching, filtering, unification, retrieval, reasoning, etc. This type of processing does not require floating point operations. Symbolic processors are also called LISP processors or PROLOG processors.

3.7 Bit-Slice Processors

The processor of desired word length is developed using the building blocks. The basic building block is called Bit-Slice where the building blocks include 4-bit ALUs, micro programs sequencers, carry look-ahead generators, etc. The word 'slice' was used because the desired number of ALUs and other components were used to build an 8-bit, 16-bit or 32-bit CPU.

Examples of Bit-Slice Processors were:

- AMD-2900, AMD 2909, AMD 2910, AMD 29300 series,
- Texas instrument's SN-74AS88XX series, etc.

3.8 Transputers

In a multiprocessor system, a transputer is a specially designed microprocessor to operate as a component processor.

Transputers were introduced in late 1980's. They were built on VLSI chip and contained a processor, memory and communication links. The communication link was to provide point-to-point connection between transputers.

A transputer contains FPU, on-chip RAM, high-speed serial link, etc.

Examples of transputers are:

- INMOS T414, INMOS T800, etc.

Where, T414 was a 32-bit processor with 2 KB memory. The T800 was FPU version of 32-bit transputer with 4 KB memory.

3.9 Graphic Processors

Graphics Processors are specially designed processors for graphics. Intel has developed Intel 740-3D graphics chip. It is optimized for Pentium II PCs, using a hyper pipelined 3D architecture with additional 2D acceleration. Like most 3D graphics chips, the I-740 will be marketed in performance, not the main stream category. It is designed mostly for such heavy multimedia uses as games and movies.

- Examples of Graphic Processors are:
- Intel 82786 graphics coprocessor
- IBM's 8514/A,
- Texas Instruments' TMS34010 and TMS34020,
- Intel i860 and Intel i750, etc.

3.10 Summary

This unit focuses on the various types of microprocessors used in modern computing and embedded systems. Students will explore categories such as general-purpose microprocessors, microcontrollers, digital signal processors (DSPs), and application-specific integrated circuits (ASICs). The lesson will cover architectural distinctions, including CISC and RISC, providing insight into how these architectures affect processing capabilities and efficiency. Additionally, students will examine real-world applications of each microprocessor type, emphasizing their roles in different technologies and industries. By the end of the lesson, students will have a well-rounded understanding of microprocessor types and their functionalities, enabling them to make informed decisions regarding microprocessor selection for specific tasks.

3.11 Assessment Questions

1. Compare and contrast CISC and RISC architectures.
2. Examine the role of microcontrollers in embedded systems.
3. Analyze the significance of digital signal processors (DSPs) in modern computing.
4. Evaluate the impact of microprocessor types on performance and application suitability.
5. Discuss the evolution of microprocessor types and their implications for future technologies.
   Trace the historic

Module 6: Computer Application Packages

Unit 1: Overview of Application Packages

Flow of the Unit

1.0 Objective
1.1 Introduction
1.2 Word Processor
1.3 Spreadsheet
1.4 Database Management System (DBMS)
1.5 Summary
1.6 Assessment Question
1.7 Reference

1.0 Objective

a. Identify the key components and functions of major application packages.
b. Demonstrate proficiency in using at least two different application packages for various tasks.
c. Analyze the benefits of using application packages in different professional contexts..

1.1 Introduction

An office suite is a collection of applications intended to be used by workers of an organization. These bundled applications can be used for several purposes like creating documents/reports, saving data on Spreadsheets, presentations on slides, sending emails, etc.

1.2 Word Processors

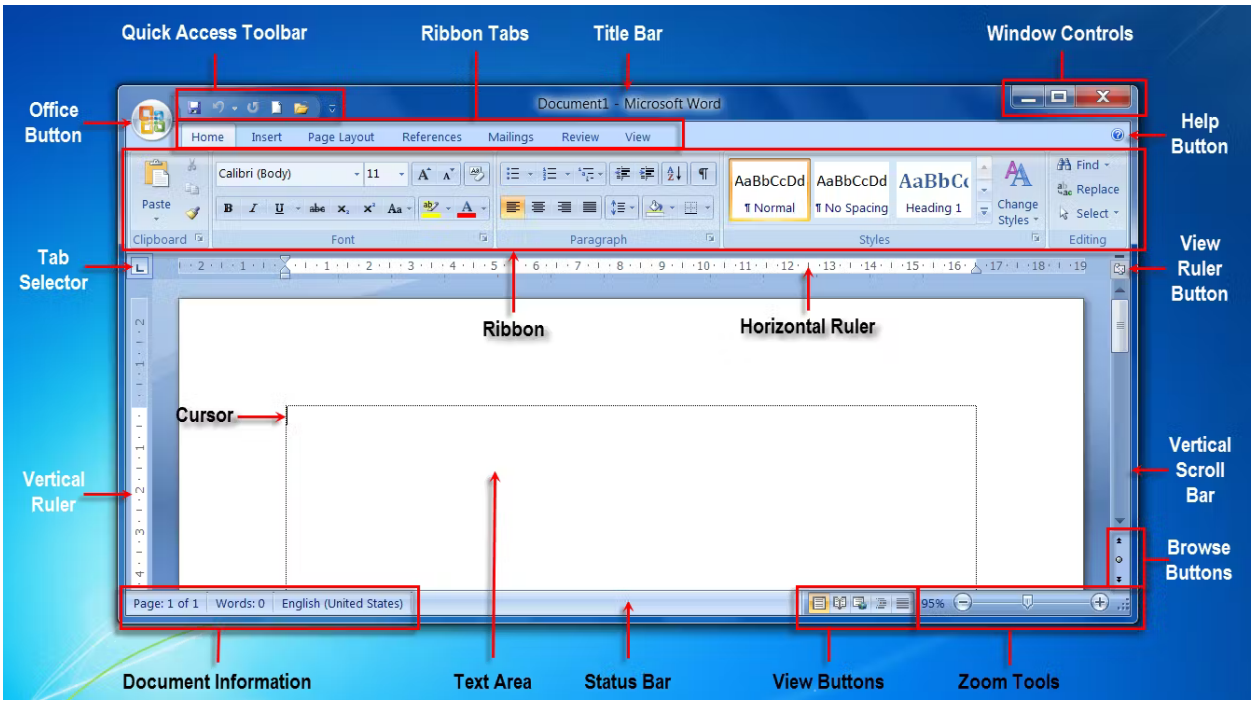
Its a software designed to create documents in text formats like applications, resumes, letters, reports, theses, etc. We can create, edit, save, share, and print documents create from this software. It also provides features such as spell and grammar checks; font-related such as size, types, and colors; inserts special symbols used in Mathematics and Sciences, etc.

Some popular word processors are MS(Microsoft) Word, Google Docs, Star Office Writers, etc. In this chapter, we'll be diving deep into MS word.

MS Word

It is a very popular software developed by Microsoft. It is one of the software that comes bundled with Microsoft's office 365 tools but can also be purchased separately.

One of the ways to start the word app is by double-clicking the docs icon. You can also start MS word from the run program in windows. You'll see a window similar to the image below.



Basic Terms Of Word Processing

1. **Quick Acess Toolbar:** As shown in the figure, it's a customizable toolbar with a few commands such as save, back/undo, etc.
2. **Title Bar:** A place that shows the file's name/title or simply document1 if you haven't named it yet.
3. **Window Controls:** Such as minimize, maximize/restore and close buttons.
4. **Ribbon:** A section consisting of menus and toolbars. It is designed to provide users with quick access to commands to complete tasks. Commands are grouped and ordered logically under tabs.
5. **Tabs/Ribbon Tabs:** Tabs organize different commands into groups based on processing activities.
6. **Scrolling Bars:** Vertical/Horizontal scroll bars to scroll through documents easily in respective directions.
7. **Rulers:** Vertical/Horizontal rulers in Microsoft Word help to see and control page margins, paragraph indents, and more. You can toggle the visibility of the ruler by checking/unchecking the box in View>Ruler(show section).

Working With File Menu

The File menu provides tools to access your files to create, read, update, delete, and print them.

1. New: Create a new document/File.
2. Open: Open a file from your directories.
3. Save: Save the changes in the file.
4. Save As: Save files with different names and/or formats such as pdf, Docx, etc.
5. Print: Print the file.

Working and Editing Text

Some keyboard shortcuts in MS word:

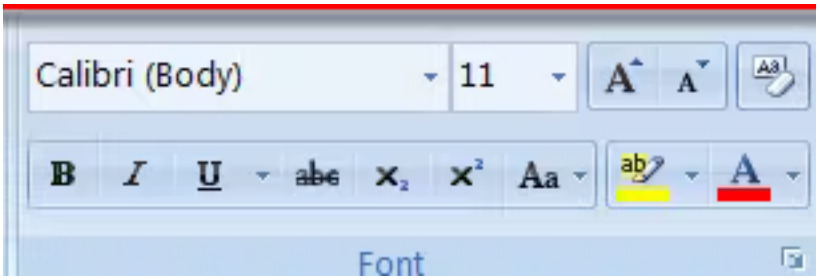
1. Ctrl+N --> Create a new document
2. Ctrl+O -->Open a document.
3. Ctrl+S --> Save the document.
4. Ctrl+W --> Close the document.
5. Ctrl+X --> Cut the selected content to the Clipboard.
6. Ctrl+C --> Copy the selected content to the Clipboard.
7. Check out different shortcuts here.

Formatting Characters and Paragraphs

The following image displays the section that can be used to

1. To change Font Families like Calibri, Sans Serif, Roboto, etc.
2. To change font size and color.
3. To change the background color of the image.
4. Align the paragraphs and head to the center, right, or left.
5. Create a bullet list like ordered or unordered. etc.

Try the exercises that are mentioned in the book to explore more about MS Word.

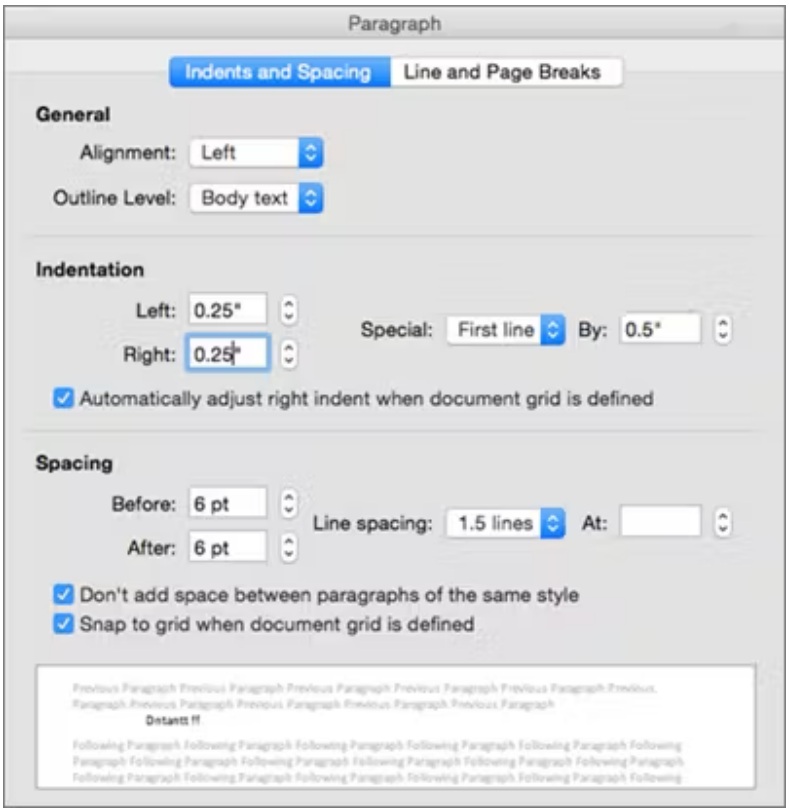


Indent Paragraphs

Indentation determines the distance of a paragraph from either right or left of the margin. You can increase or decrease the indent of the paragraph, and create an indent on all lines except the first line(hanging indent) with ms word.

You can launch the paragraph window from the home tab, Clicking the bottom-facing arrow button, similar to the image below.

You'll see a dialog box like the image below.



Play with the settings the see the changes.

Check out the book to learn how to:

1. Insert symbols and equations.
2. Insert header and footer in the document page.

3. Formatting pages from the page layout tab.
4. Provide numbering, and borders on pages.
5. Insert tables in docs.
6. Insert Images and Clip art in documents.

Working With Templates

A template determines the basic structure of a document. It contains settings for documents such as fonts, macros, menus, page layouts, styles, etc. Ms word comes with several global templates under the Templates dialog box such as resumes, applications, letters, etc.

Performing Mail Merge

Mail merge is the process of combining two or more files/letters/emails. It can be used for mass(multiple) mailings from one letter. It can also be used to print individual mark sheets from the result sheet Excel.

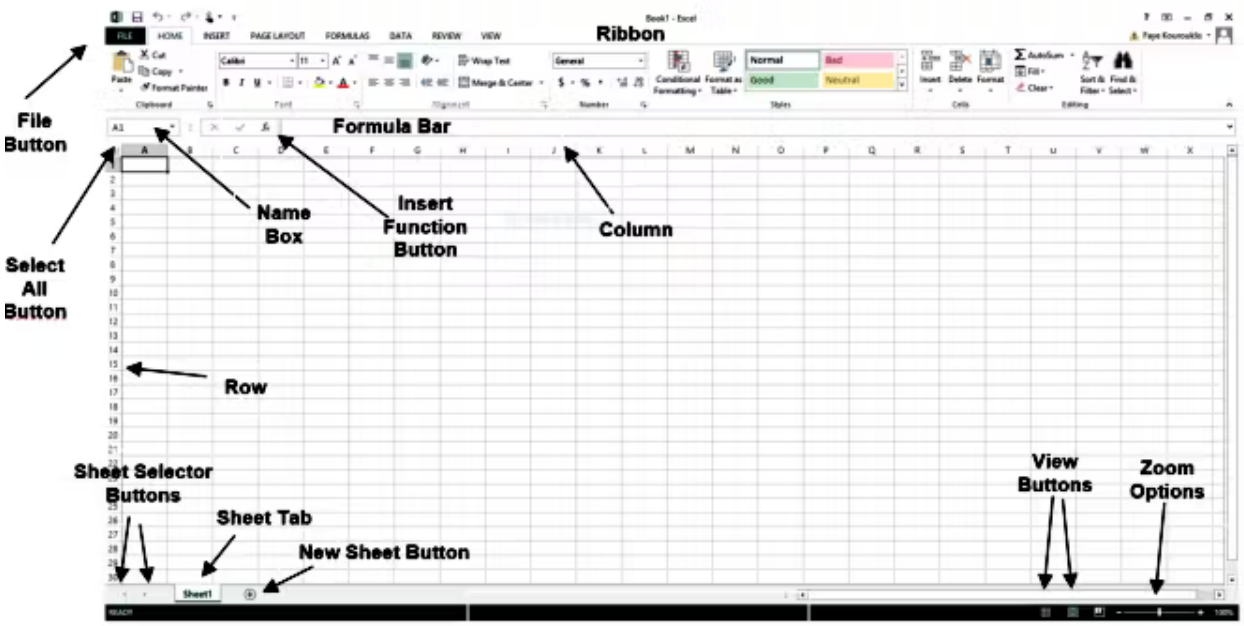
1.3 Spreadsheets

A spreadsheet is an online document that organizes data in rows and columns. We can apply different mathematical formulas and generate charts and graphs based on data.

There are different types of spreadsheets, for instance, MS Excel, Google Spreadsheets, Apple Numbers, etc. MS Excel which we'll explore further is a product by Microsoft.

MS Excel

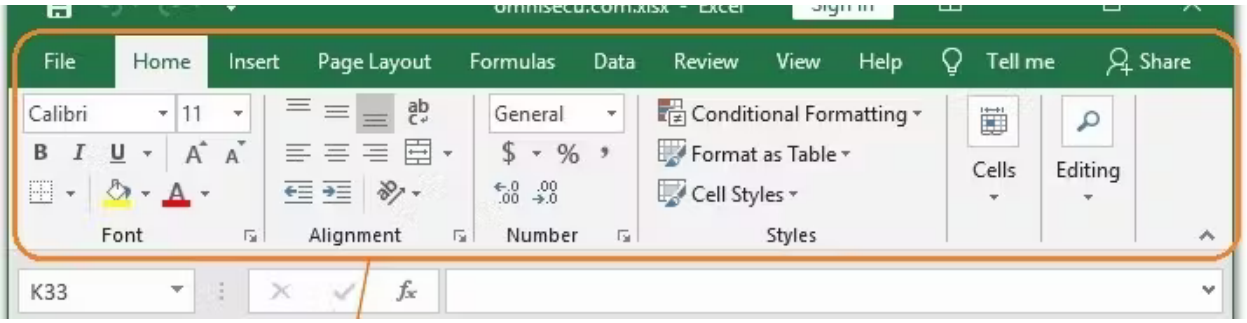
Helpful Terms in MS Excel



1. **Tabs:** Tabs/Sheet tab gives access to select individual spreadsheets/worksheets.
2. **Ribbon Tabs:** Ribbon Tab is a tab that organizes commands by topic. The Ribbon is Commands underneath the Tabs
3. **Name Box:** Displays cell location and can be used to navigate to a cell location
4. **Select All Button:** Selects all the cells in a worksheet
5. **Formula Bar:** It's a horizontal bar, sometimes called an fx bar. It displays text or number data in active or current cells, formulas in an active cell, or a range of cells in place of a selected data series in Excel.
6. **Insert Function Button:** Displays Insert Function dialog box.
7. **Cell:** A cell is a rectangular area formed by the intersection of a column and a row.
8. **Cell Range:** It's a collection of multiple continuous cells. Cell Ranges are given as, A1:C23. This means from Column A row 1 to Column C row 23.
9. Cell References/ Cell Address: Each Cell has its reference. For example, A5 cell means the cell in the 5th row of column A. There are two cell references. They are absolute and relative cell references.

Relative references are given by combining their Column Name and cell numbers like B5, A22, K2, etc. Relative references change when a formula is copied to another cell.

Absolute references, on the other hand, remain constant no matter where they are copied. They are referred to as A5, B12, etc.



After this, you can explore things on spreadsheets like:

1. Create Header Row. Add background and font colors, and add wraps.
2. Try to change the alignments of the column.
3. You can also try changing the alignment of values in different cells.
4. Try inserting, merging, and deleting rows and columns.

1.4 Database Management System (DBMS)

DBMS is software for creating and managing databases. A DBMS makes it possible for users to create, protect, read, update and delete data in a database. Microsoft offers MS Access as part of Office 365 as a database management system(DBMS). Libre Office comes free with Linux installations and has LibreOffice Base as DBMS.

MS Access

You can open check this article on how to create a new DB with MS Access in very easy steps. You can also follow the following steps:

1. Start Microsoft Access, click the File tab on the ribbon, and select New.
2. Type the name of the DB you want to create in the input box and hit enter. Access will display a list of templates that match the term you entered.
3. Choose a template from the given list
4. Give a name to your DB.
5. Click the Create button or the Download button.

After that, access will open up a new window with your DB.

Data Types

In access, data are stored in a table in column and row combination. Each field/column has distinct characteristics. One of them is the data type of the value that the column will hold.

1. **Short Text:** It's the combination of strings as well as numbers. However, the numbers won't be used for any calculations like phone numbers, and postal codes in addresses. The maximum length of a short text is up to 255 characters. It's perfect for fields like name, address, gender, etc.
2. **Long Text:** Similar to a short text, however, its length can be up to 63,999 characters. It's perfect for values like long paragraphs.
3. **Date/Time:** Date and time values from years 100 to 9999.

Other data types are Numbers, Currency, AutoNumbers, and Yes/No booleans. Find about them in the book.

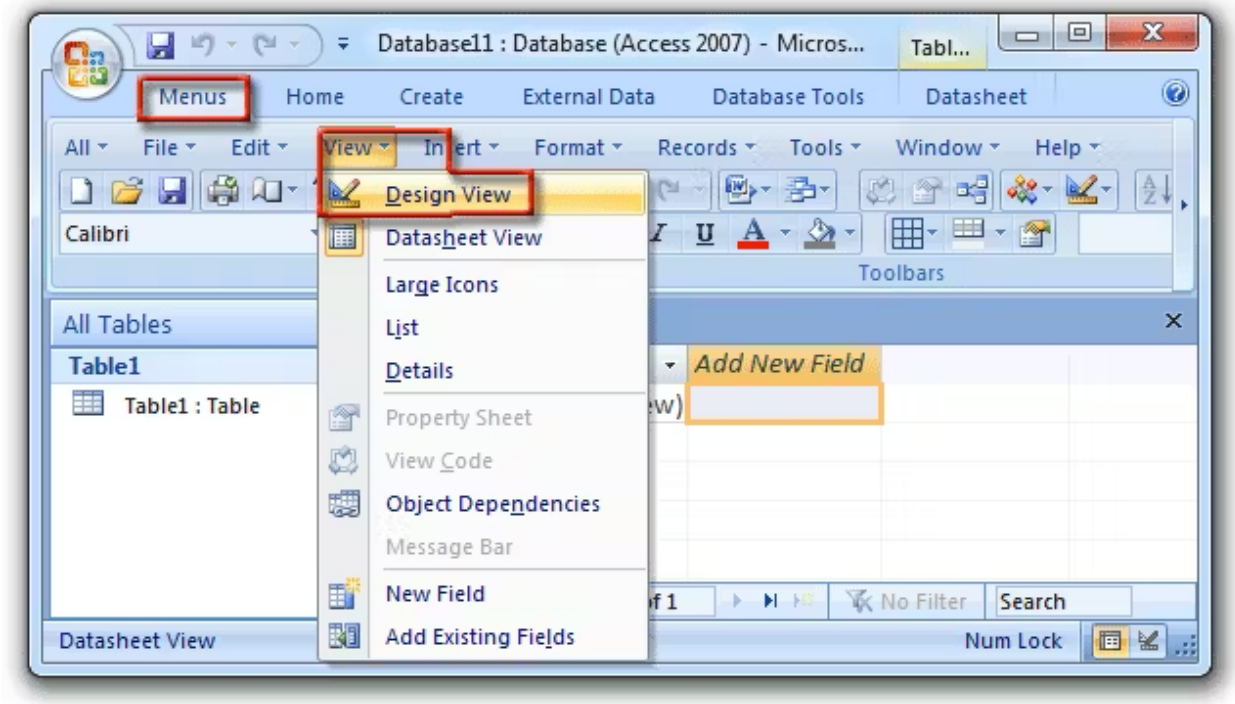
Create Table

Always start your DB design by creating all of its tables. Before creating a table it's better to write down on paper all the tables you might need for your database and also the fields for your tables. For instance, To create a DB for a retail store what are the tables that are needed?

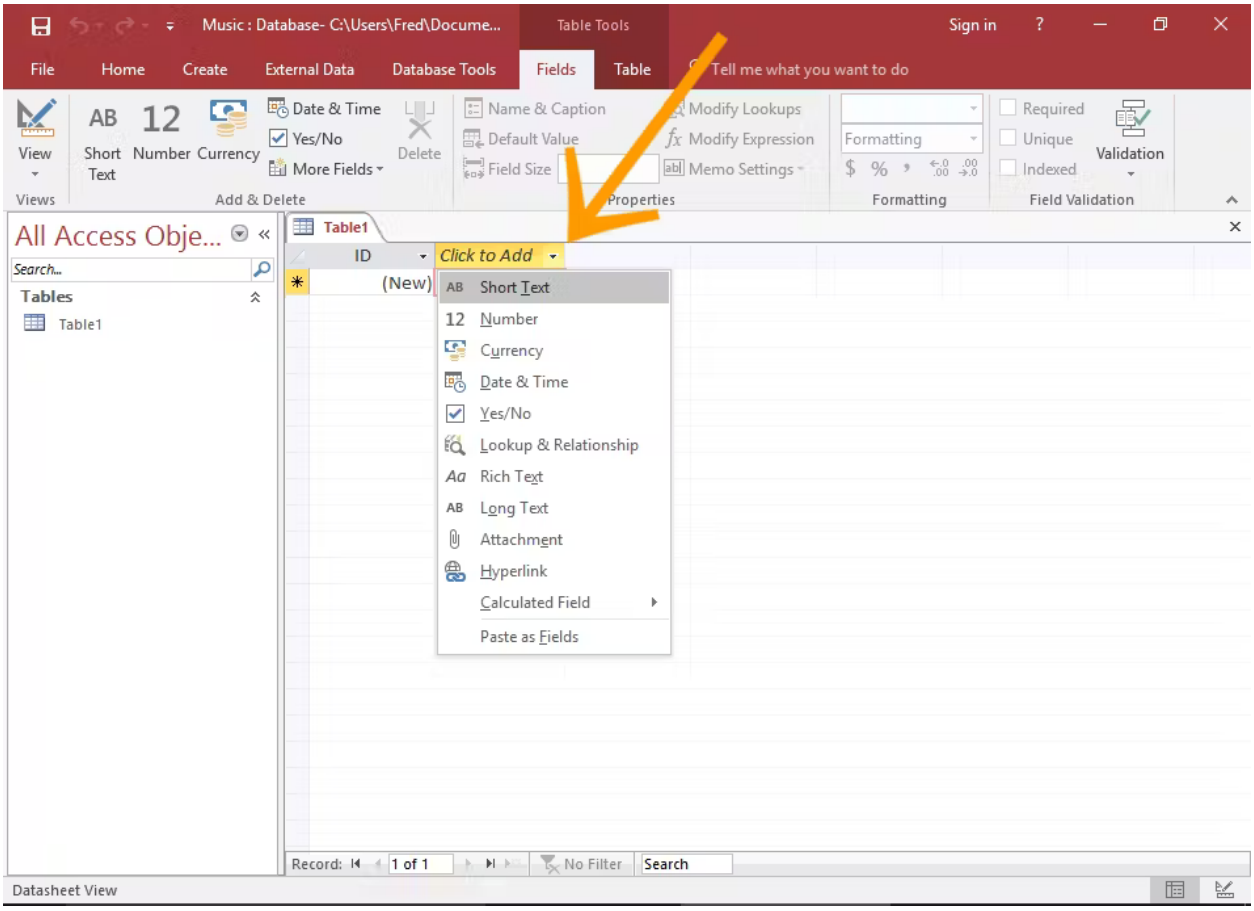
1. Inventory table that lists all the items, their quantity, expiration date, time of purchase, etc.
2. Staff Shift table that has a list of staff names, Unique IDs, Shift days and times, overtime, phone numbers, etc.
3. Suppliers table that has information on product suppliers to your store such as Organization Name, address, phone number, contact person name, etc.
4. Transaction table that lists daily transactions in your store.

You can create a table in the datasheet view as well as in the design view. Follow the following steps to reach the specific views to create tables.

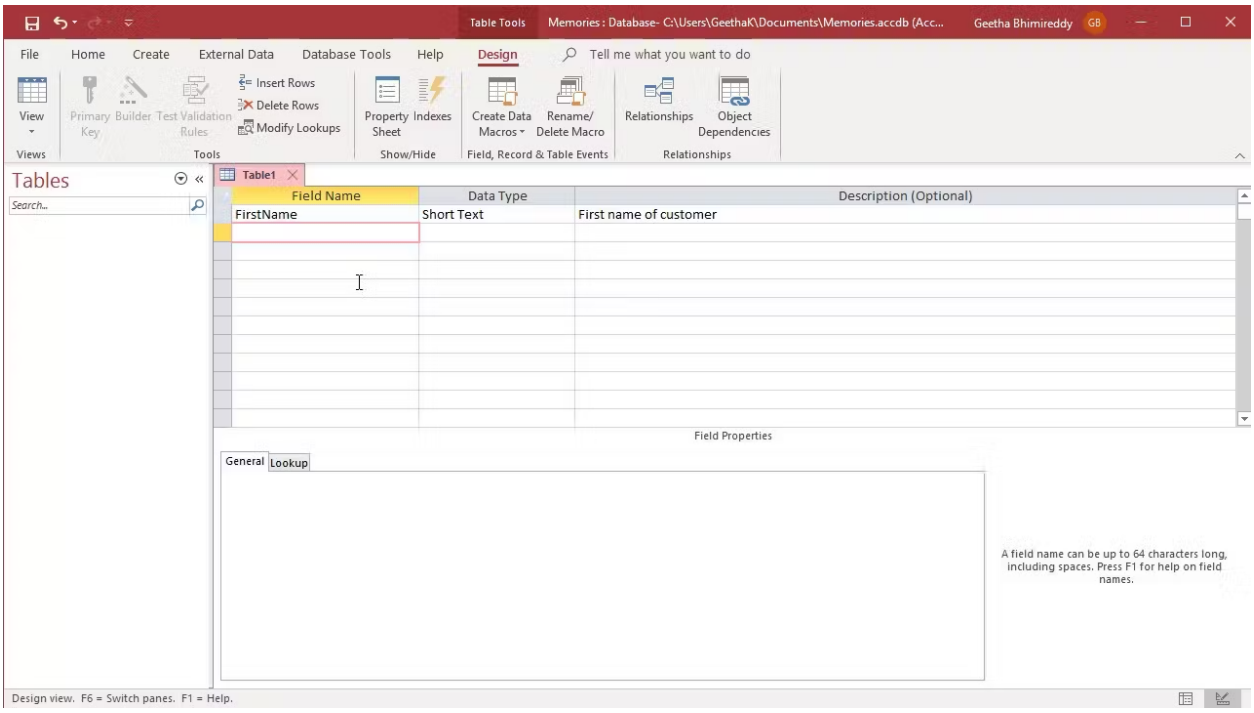
Change Views. Image Source



Create a Table in Datasheet View. Image Source



Create a Table in Design View. Image Source



Adding Data

A database is a collection of objects like tables, forms, reports, etc. Now that the table is ready we need to add data to them. You can insert, change, or delete data in the table from MS Access in the datasheet view.

1.6 Summary

Application packages are software suites designed to help users perform specific tasks efficiently. They typically include a range of tools that support various functions such as word processing, spreadsheet management, database management, and presentation creation. Popular application packages include Microsoft Office Suite (Word, Excel, PowerPoint), Google Workspace (Docs, Sheets, Slides), and open-source alternatives like LibreOffice.

These packages often feature user-friendly interfaces, built-in templates, and collaboration tools that facilitate teamwork. They also support file sharing and compatibility with various operating systems. Understanding the functionalities and uses of these applications is crucial for enhancing productivity in both personal and professional settings.

1.7 Assessment Question

1. Explain the main features of Microsoft Word and how they contribute to efficient document creation.
2. Compare and contrast the functionalities of Microsoft Excel and Google Sheets. In what scenarios would one be preferred over the other?
3. Imagine you are tasked with creating a presentation for a business proposal. Describe how you would utilize application packages to complete this task, including specific tools and features you would use.
4. Discuss the impact of cloud-based application packages (e.g., Google Workspace) on teamwork and collaboration compared to traditional desktop applications (e.g., Microsoft Office).

Module 6: Computer Application Packages

Unit 2: Use of Microsoft Word Package

Flow of the Unit

2.0 Objective
2.1 Basics of MS Word
2.2 Features of MS Word
2.3 Uses of MS Word
2.4 Summary
2.5 Assessment Question
2.6 Reference

2.0 Objective

a. Describe System Development Life Cycle (SDLC).
b. Able to describe each stage involve in implementing SLDC.
c. Identify stages involve in SDLC

2.1 Basics of Microsoft Word

Let us first understand some basic aspects of Microsoft Word.

What is MS Word?

Used to make professional-quality documents, letters, reports, etc., MS Word is a word processor developed by Microsoft. It has advanced features which allow you to format and edit your files and documents in the best possible way.

Where to find MS Word on your personal computer?

Follow these simple steps to open MS Word on your personal computer:

Start → All Programs → MS Office → MS Word.

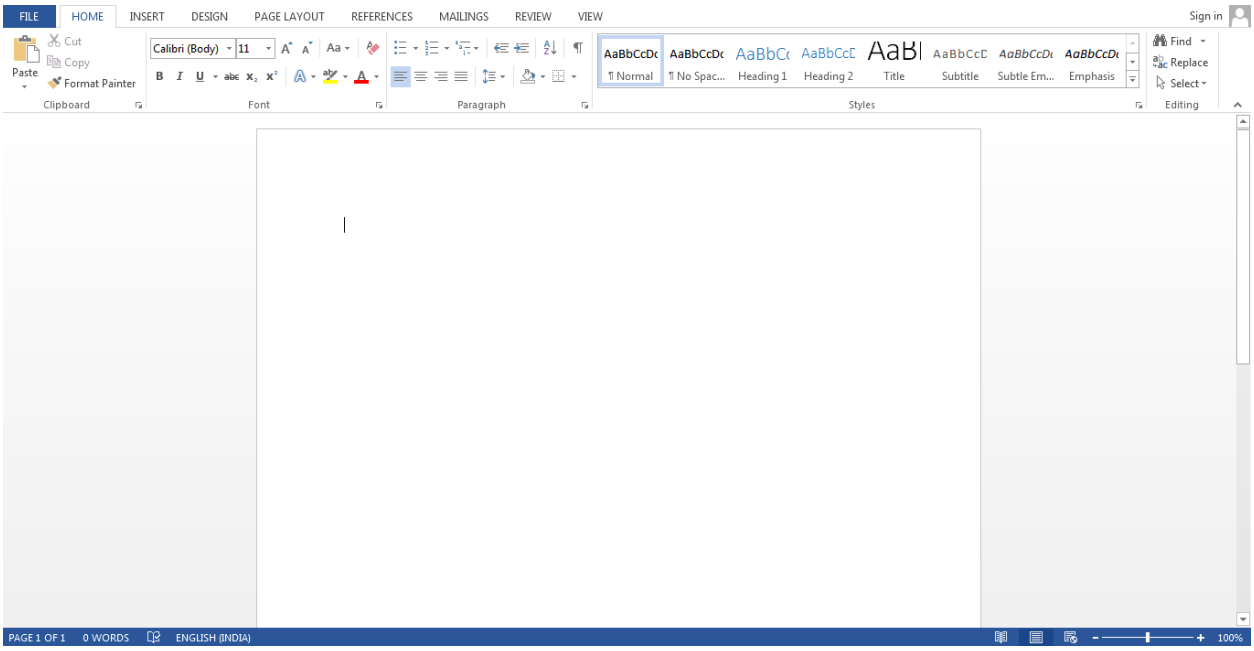
What are the uses of MS Word?

MS Word enables users to do write-ups, create documents, resumes, contracts, etc. This is one of the most commonly used programs under the Office suite.

How to create an MS Word document?

To create an MS Word doc, follow the steps mentioned above to open Microsoft Word. Then once the program is open, click on "File" followed by "New". This opens a new doc where something new can be created.

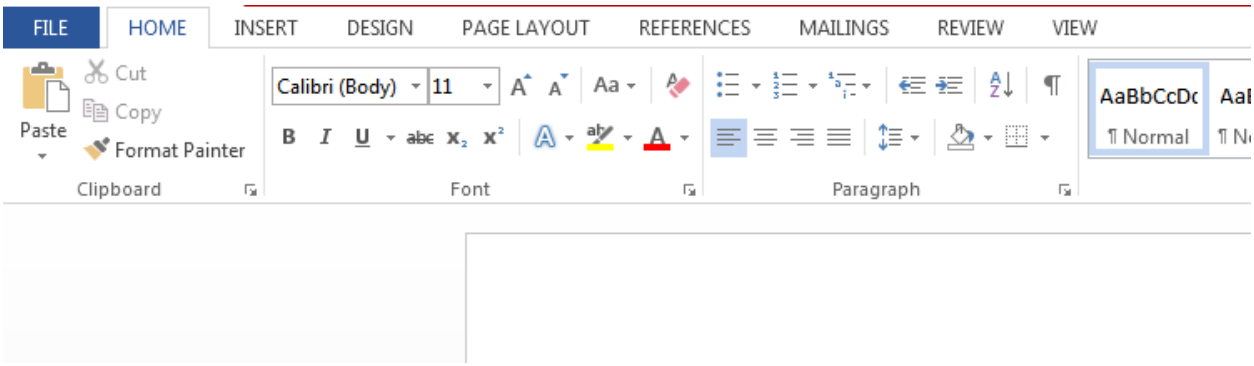
Since it is used by people of all age groups, in schools, in colleges and for official purposes, having proper knowledge of Microsoft Word is a must. The preview of the MS Doc file once it is opened is given below:



2.2 Features of MS Word

Now let us read more about the features and components of an MS Word doc file in detail.

The image given below shows the different elements and categories which are available in MS Word doc:



- **Home:** This has options like font colour, font size, font style, alignment, bullets, line spacing, etc. All the basic elements which one may need to edit their document is available under the Home option.
- **Insert:** Tables, shapes, images, charts, graphs, header, footer, page number, etc. can all be entered in the document. They are included in the "Insert" category.
- **Design:** The template or the design in which you want your document to be created can be selected under the Design tab. Choosing an appropriate tab will enhance the appearance of your document.
- **Page Layout:** Under the Page Layout tab comes options like margins, orientation, columns, lines, indentation, spacing, etc.
- **References:** This tab is the most useful for those who are creating a thesis or writing books or lengthy documents. Options like citation, footnote, table of contents, caption, bibliography, etc. can be found under this tab.
- **Review:** Spell check, grammar, Thesaurus, word count, language, translation, comments, etc. can all be tracked under the review tab. This acts as an advantage for those who get their documents reviewed on MS Word.

Apart from all the above-mentioned features, the page can be set in different views and layouts, which can be added and optimised using the View tab on the Word document. Margins and scales are also available for the benefit of the users.

2.3 Uses of MS Word

Given below are the different fields in which MS Word is used and simplifies the work of an individual:

- **In Education:** It is considered as one of the simplest tools which can be used by both teachers and students. Creating notes is easier using MS Word as they can be made more interactive by adding shapes and images. It is also convenient to make assignments on MS Word and submitting them online
- **In Workplace:** Submitting letters, bills, creating reports, letterheads, sample documents, can all easily be done using MS Word
- **Creating & Updating Resume:** One of the best tools to create your resumes and is easy to edit and make changes in it as per your experience
- **For Authors:** Since separate options are available for bibliography, table of contents, etc., it is the best tool which can be used by authors for writing books and adjusting it as per the layout and alignment of your choice

Also, creating a Doc file and converting it into PDF is a more suitable option, so it is highly recommended.

2.4 Summary

This unit more understandable, and students study more proficiently using Microsoft Word. Hopefully, the above-mentioned uses will help you a better understanding of Microsoft Word for the education sector.

2.5 Assessment Question

1. Which formatting features can be added to the MS Word document?
2. What is Microsoft Word used for??
3. What are the basic functions of MS Word?
4. What is the extension of an MS Word file?
5. What are the five basic fields of application for MS Word?

Module 6: Computer Application Packages

Unit 3: Use of Electronic Spreadsheet (Microsoft Excel)

Flow of the Unit

3.0 Objective
3.1 Excel spreadsheet
3.2 Features of spreadsheet
3.3 Functions of spreadsheet
3.4 Uses of spreadsheet
3.5 Component of spreadsheet
3.6 Best spreadsheet application
3.7 Summary
3.8 Assessment questions
3.9 Reference

3.0 Objective

a. Identify the key features and functionalities of electronic spreadsheet applications.
b. Demonstrate proficiency in creating, editing, and analyzing data within an electronic spreadsheet.
c. Apply formulas and functions to solve real-world problems using spreadsheet software.
d. Create visual representations of data through charts and graphs.

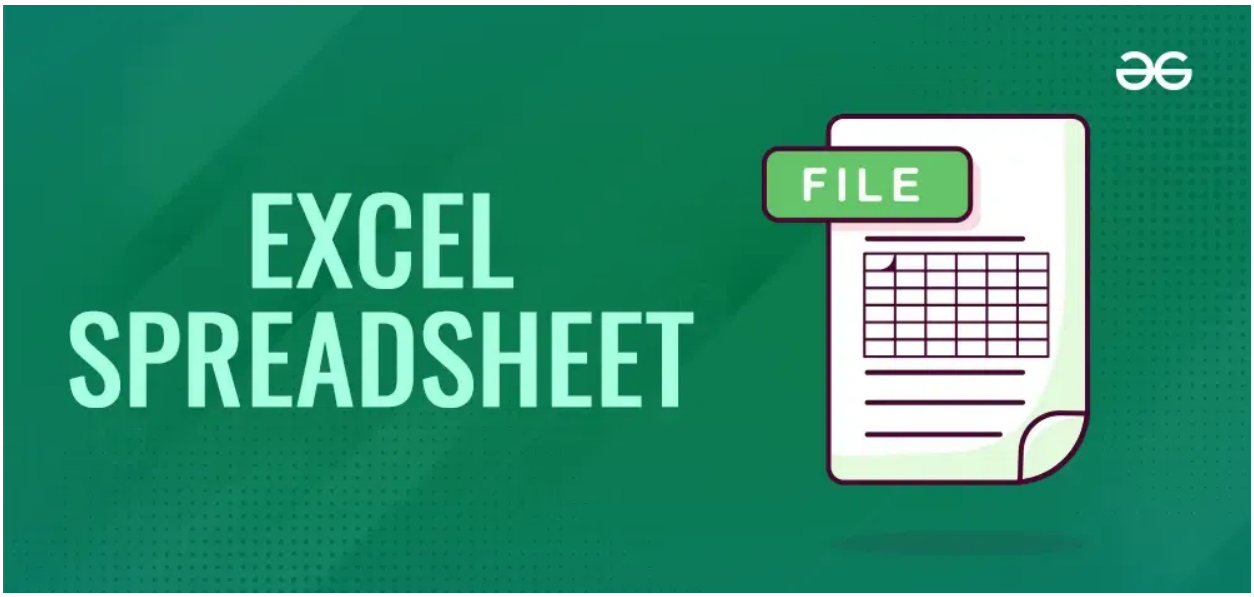
3.1 Excel Spreadsheet

A Spreadsheet is a computer application that is designed to add, display, analyze, organize, and manipulate data arranged in rows and columns. It is the most popular application for accounting, analytics, data presentation, etc. In other words, spreadsheets are scalable grid-based files that are used to organize data and perform calculations. People all across the world use spreadsheets to create tables for personal and business usage.

You can also use the tool's features and formulas to help you make sense of your data.

For example – You may track data in a spreadsheet and see sums, differences, multiplication, division, and fill dates automatically, among other things. Microsoft Excel, Google Sheets, Apache Open Office, LibreOffice, etc. are some spreadsheet software. Among all these software, Microsoft Excel is the most commonly used spreadsheet tool and it is available for Windows, macOS, Android, etc.

Excel offers a variety of functionalities, including Excel sheet unprotect options for safeguarding and managing data. You can start with Excel spreadsheet templates to simplify your work, whether you're creating an Excel spreadsheet for project management or an Excel spreadsheet for budgeting. The standard file format for Excel is the Excel file extension .xlsx, which ensures compatibility and ease of use across different platforms.



Source: https://media.geeksforgeeks.org/wp-content/uploads/20240627130316/What-is-a-Excel-Spreadsheet.webp

A collection of spreadsheets is known as a workbook. Every Excel file is called a workbook. Every time you start a new project in Excel, you'll need to create a new workbook.

There are several methods for getting started with an Excel workbook. To create a new worksheet or access an existing one, you can either start from scratch or utilize a pre-designed template. A single Excel worksheet is a tabular spreadsheet that consists of a matrix of rectangular cells grouped in rows and columns. It has a total of 1,048,576 rows and 16,384 columns, resulting in 17,179,869,184 cells on a single page of a Microsoft Excel spreadsheet where you may write, modify, and manage your data.

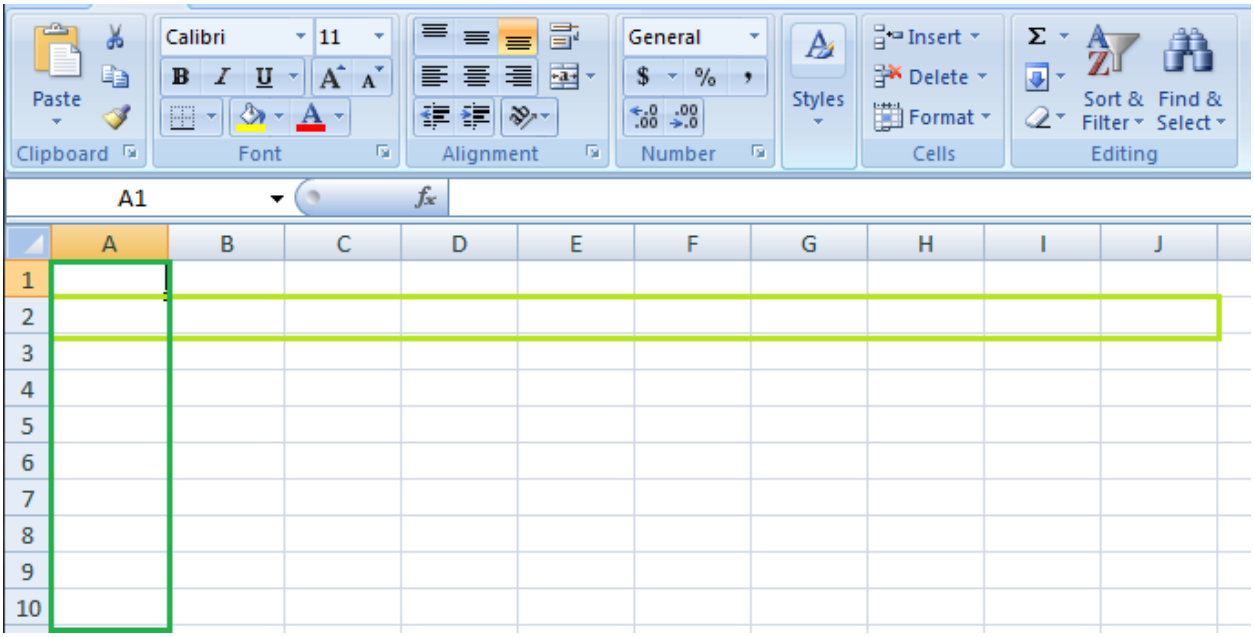
In the same way as a file or a book is made up of one or more worksheets that contain various types of related data, an Excel workbook is made up of one or more worksheets. You can also create and save an endless number of worksheets. The major purpose is to collect all relevant data in one place but in many categories (worksheet).

3.2 Features of Spreadsheet

As we know that there are so many spreadsheet applications available in the market. So these applications provide the following basic features:

Rows and columns

Rows and columns are two distinct features in a spreadsheet that come together to make a cell, a range, or a table. In general, columns are the vertical portion of an excel worksheet, and there can be 256 of them in a worksheet, whereas rows are the horizontal portion, and there can be 1048576 of them.



The color light green is used to highlight Row 3 while the color green is used to highlight Column B. Each column has 1048576 rows and each row has 256 columns.

Cell Formatting

Cell formatting in Microsoft Excel refers to the process of changing the appearance of cells in a worksheet to improve readability, highlight important information, and make data presentation more visually appealing. Formatting can include changes to the font, color, borders, alignment, and number formats of the cells.

Formulas

In spreadsheets, formulas process data automatically. It takes data from the specified area of the spreadsheet as input then processes that data, and then displays the output into the new area of the spreadsheet according to where the formula is written. In Excel, we can use formulas simply by

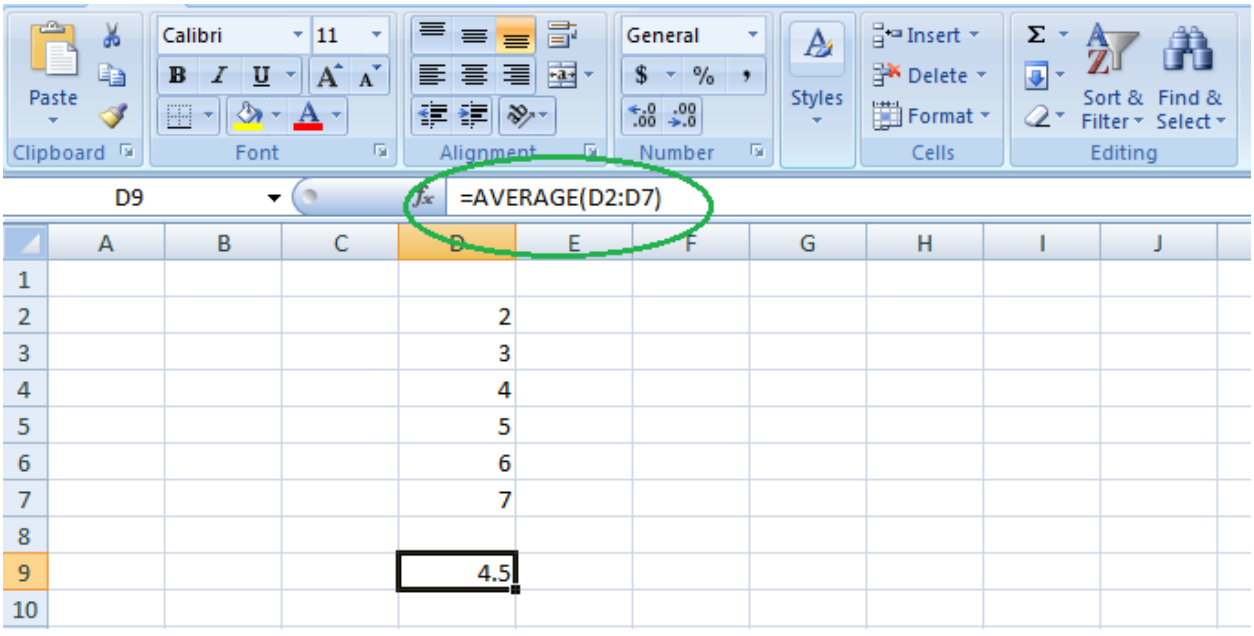
typing "=Formula Name(Arguments)" to use predefined Excel formulas. When you write the first few characters of any formula, Excel displays a drop-down menu of formulas that match that character sequence. Some of the commonly used formulas are:

- ***=SUM(Arg1: Arg2):*** It is used to find the sum of all the numeric data specified in the given range of numbers.
- ***=COUNT(Arg1: Arg2):*** It is used to count all the number of cells(it will count only number) specified in the given range of numbers.
- ***=MAX(Arg1: Arg2):*** It is used to find the maximum number from the given range of numbers.
- ***=MIN(Arg1: Arg2):*** It is used to find the minimum number from the given range of numbers.
- ***=TODAY():*** It is used to find today's date.
- ***=SQRT(Arg1):*** It is used to find the square root of the specified cell.

For example, you can use the formula to find the average of the integers in column C from row 2 to row 7:

= AVERAGE(D2:D7)

The range of values on which you want to average is defined by D2:D6. The formula is located near the name field on the formula tab.



We wrote =AVERAGE(D2:D6) in cell D9, therefore the average becomes (2 + 3 + 4 + 5 + 6 + 7)/6 = 27/6 = 4.5. So you can quickly create a workbook, work on it, browse through it, and save it in this manner.

Pivot Table

The Pivot Table feature in Microsoft Excel is a powerful tool for data analysis and reporting. It allows users to quickly summarize, analyze, and explore large sets of data by creating dynamic, interactive tables. With Pivot Tables, you can easily reorganize and aggregate data to gain insights and present information in a meaningful way.

3.3 Functions of SpreadSheet

In spreadsheets, the function uses a specified formula on the input and generates output. Or in other words, functions are created to perform complicated math problems in spreadsheets without using actual formulas. For example, if you want to find the total of the numeric data present in the column then use the SUM function instead of adding all the values present in the column.

Text Manipulation

The spreadsheet provides various types of commands to manipulate the data present in it.

Pivot Tables: It is the most commonly used feature of the spreadsheet. Using this table users can organize, group, total, or sort data using the toolbar. Or in other words, pivot tables are used to summarize lots of data. It converts tons of data into a few rows and columns.

3.4 Uses of Spreadsheets

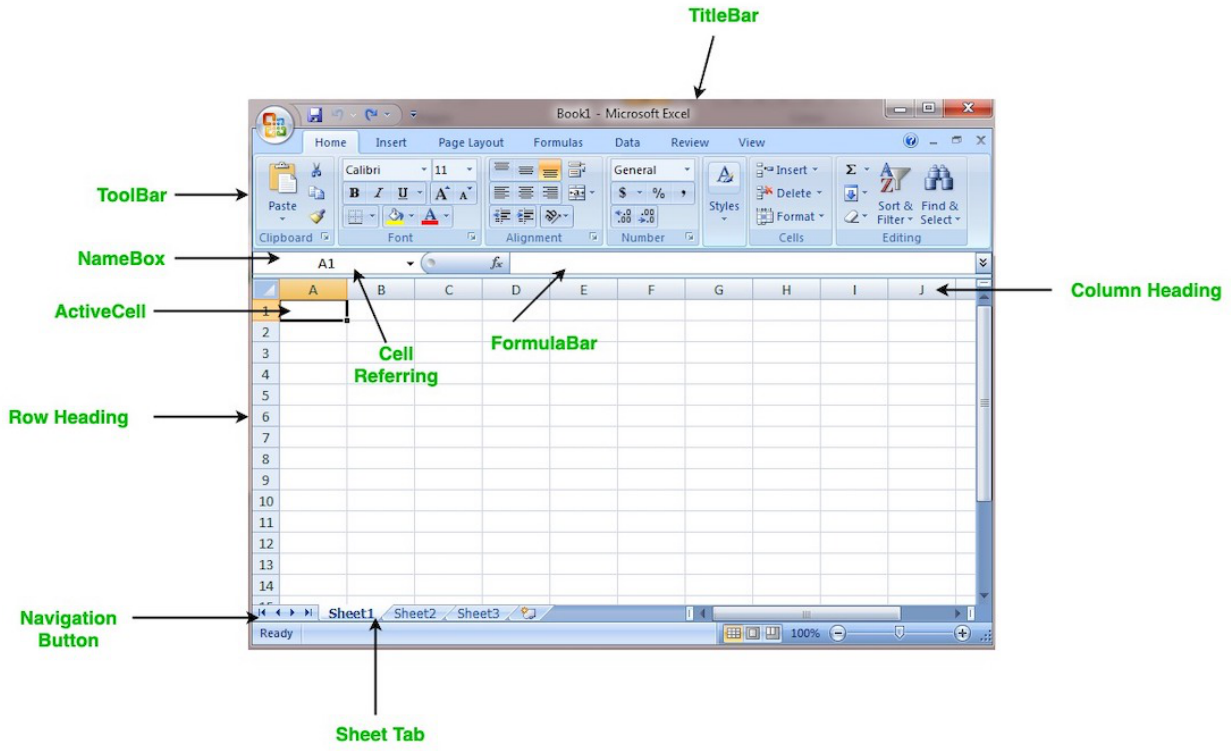
The use of Spreadsheets is endless. It is generally used with anything that contains numbers. Some of the common use of spreadsheets are:

1. **Finance:** Spreadsheets are used for financial data like it is used for checking account information, taxes, transaction, billing, budgets, etc.
2. **Forms:** A spreadsheet is used to create form templates to manage performance review, timesheets, surveys, etc.
3. **School and colleges**: Spreadsheets are most commonly used in schools and colleges to manage student's data like their attendance, grades, etc.
4. **Lists:** Spreadsheets are also used to create lists like grocery lists, to-do lists, contact detail, etc.

5. **Hotels:** Spreadsheets are also used in hotels to manage the data of their customers like their personal information, room numbers, check-in date, check-out date, etc.

3.5 Components of Spreadsheets

The basic components of spreadsheets are:



1. **TitleBar:** The title bar displays the name of the spreadsheet and application.
2. **Toolbar:** It displays all the options or commands available in Excel for use.
3. **NameBox:** It displays the address of the current or active cell.
4. **Formula Bar:** It is used to display the data entered by us in the active cell. Also, this bar is used to apply formulas to the data of the spreadsheet.
5. **Column Headings:** Every Excel spreadsheet contains 256 columns and each column present in the spreadsheet is named by letters or a combination of letters.
6. **Row Headings:** Every Excel spreadsheet contains 65,536 rows and each row present in the spreadsheet is named by a number.
7. **Cell:** In a spreadsheet, everything like a numeric value, functions, expressions, etc., is recorded in the cell. Or we can say that an intersection of rows and columns is known as a

cell. Every cell has its own name or address according to its column and rows and when the cursor is present on the first cell then that cell is known as an active cell.

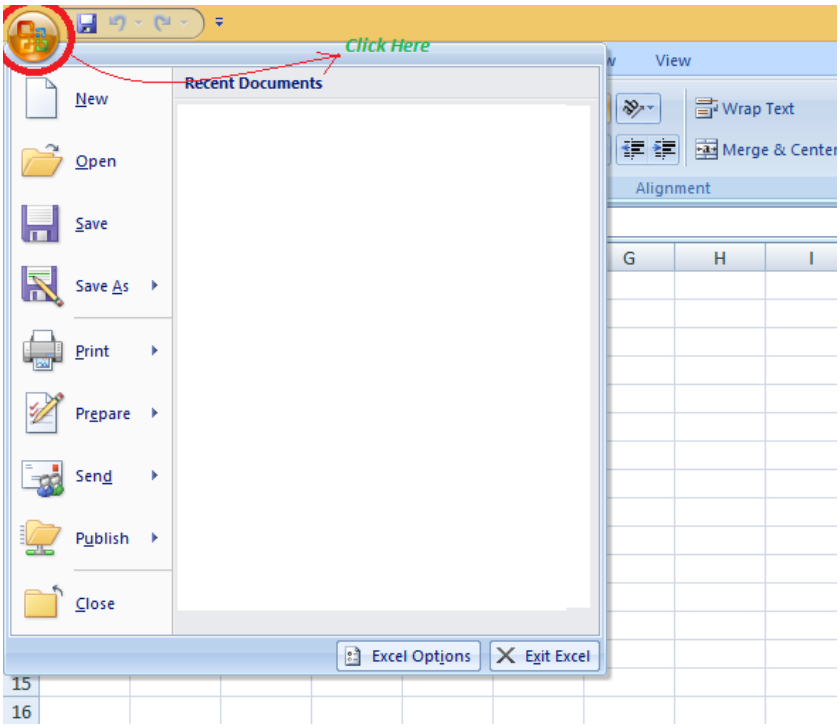
8. **Cell referring**: A cell reference, also known as a cell address, is a way for describing a cell on a worksheet that combines a column letter and a row number. We can refer to any cell on the worksheet using cell references (in excel formulae). As shown in the above image the cell in column A and row 1 is referred to as A1. Such notations can be used in any formula or to duplicate the value of one cell to another (by using = A1).
9. **Navigation buttons:** A spreadsheet contains first, previous, next, and last navigation buttons. These buttons are used to move from one worksheet to another workbook.
10. **Sheet tabs:** As we know that a workbook is a collection of worksheets. So this tab contains all the worksheets present in the workbook, by default it contains three worksheets but you can add more according to your requirement.

How to Create a New Spreadsheet or Workbook

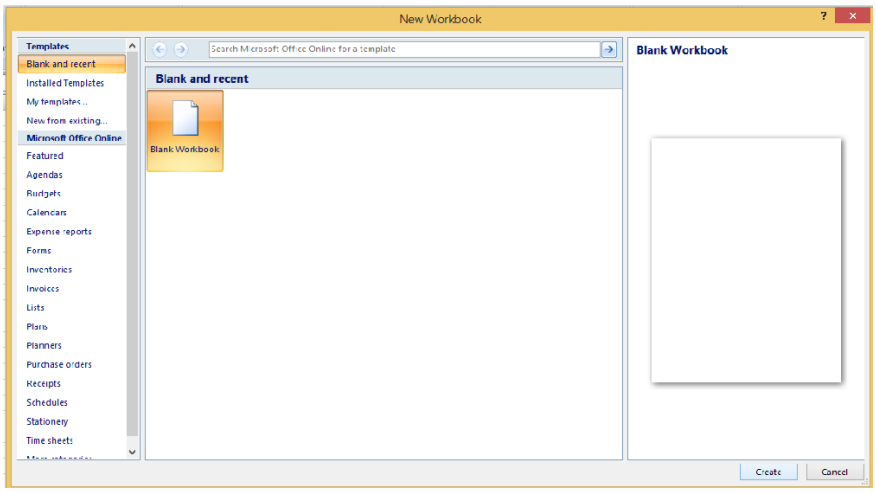
To create a new spreadsheet follow the following steps:

Step 1: Click on the top-left, Microsoft Office button and a drop-down menu appear.

Step 2: Now select New from the menu.



Step 3: After selecting the New option a New Workbook dialogue box will appear and then in Create tab, click on the blank Document.



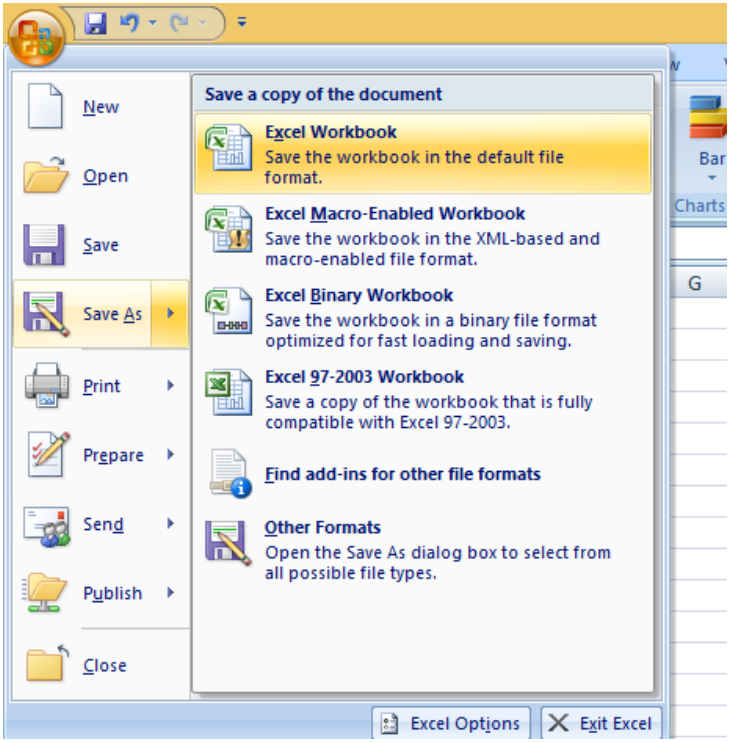
A new blank worksheet is created and is shown on your screen.

Note: When you open MS Excel on your computer, it creates a new Workbook for you.

How to Save the Workbook

In Excel we can save a workbook using the following steps:

Step 1: Click on the top-left, Microsoft office button and we get a drop-down menu:


New
Open
Save
Save As
Print
Prepare
Send
Publish
Close
Save a copy of the document
Excel Workbook
Save the workbook in the default file format.
Excel Macro-Enabled Workbook
Save the workbook in the XML-based and macro-enabled file format.
Excel Binary Workbook
Save the workbook in a binary file format optimized for fast loading and saving.
Excel 97-2003 Workbook
Save a copy of the workbook that is fully compatible with Excel 97-2003.
Find add-ins for other file formats
Other Formats
Open the Save As dialog box to select from all possible file types.
Excel Options
Exit Excel

Step 2: Now Save or Save As are the options to save the workbook, so choose one.

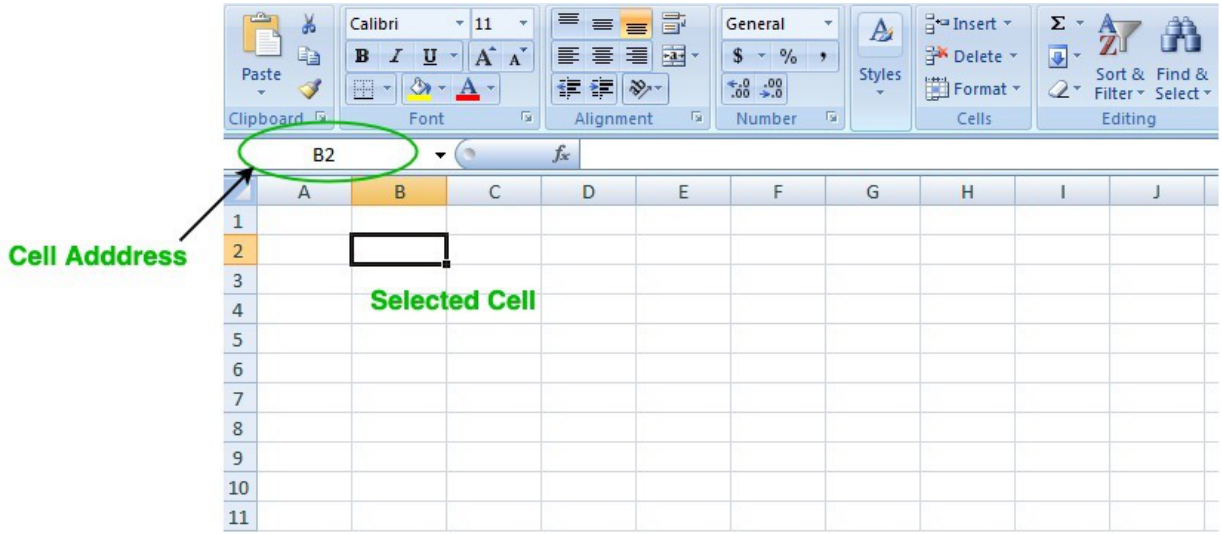
Save As: To name the spreadsheet and then save it to a specific location. Select Save As if you wish to save the file for the first time, or if you want to save it with a new name.

Save: To save your work, select Save/ click ctrl + S if the file has already been named.

So this is how you can save a workbook in Excel.

Inserting text in Excel Spreadsheet

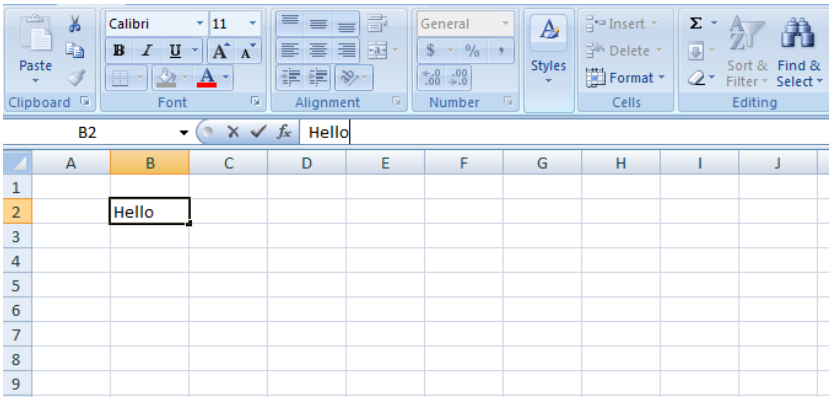
Excel consists of many rows and columns, each rectangular box in a row or column is referred to as a Cell. So, the combination of a column letter and a row number can be used to find a cell address on a worksheet or spreadsheet. We can refer to any cell in the worksheet using these addresses (in excel formulas). The name box on the top left(below the Home tab) displays the cell's address whenever you click the cell.



To insert the data into the cell follow the following steps:

Step 1: Go to a cell and click on it

Step 2: By typing something on the keyboard, you can insert your data (In that selected cell).



Whatever text you type displays in the formula bar as well (for that cell).

How to Edit/ Delete Cell Contents in the Excel Spreadsheet

To delete cell content follow the following steps:

Step 1: To alter or delete the text in a cell, first select it.

Step 2: Press the Backspace key on your keyboard to delete and correct text. Alternatively, hit the Delete key to delete the whole contents of a cell. You can also edit and delete text using the formula bar. Simply select the cell and move the pointer to the formula bar.

3.6 Best Spreadhseet Applications

Below are some common spreadsheet application in excel

Microsoft Excel

As a component of the Microsoft Office suite and the cloud-based Microsoft 365 subscription service (formerly known as Office 365), it is accessible on Windows, macOS, Android, and iOS platforms.

Google Sheet

Google Sheets is free and also available as a desktop application for Google Chrome OS and assorted mobile OSes, such as Android and iOS.

Apache Open Office

Free open-source office suite for word processing, spreadsheets, presentations, graphics, databases. Accessible on Windows, macOS, Linux.

LibreOffice

LibreOffice includes a comprehensive spreadsheet application as part of its free software suite. Both LibreOffice and Apache OpenOffice share a common codebase, leading to their similar spreadsheet applications.

3.7 Summary

Electronic spreadsheet application packages are software tools designed for organizing, analyzing, and storing data in tabular form. These applications enable users to perform complex calculations, create graphs, and manipulate data efficiently. Commonly used spreadsheet applications include Microsoft Excel, Google Sheets, and LibreOffice Calc.

Understanding how to use electronic spreadsheet applications is crucial for various fields, including finance, marketing, research, and education, as they enhance data-driven decision-making and improve productivity.

3.8 Assessment Question

1. Describe the purpose of using formulas in electronic spreadsheets and provide an example of a common formula used in data analysis.
2. Given a dataset, outline the steps you would take to create a pivot table and explain its significance in analyzing data.
3. Compare and contrast the features of Microsoft Excel and Google Sheets. Discuss which application might be more beneficial for collaborative projects.
4. You are tasked with budgeting for a project. Describe how you would use an electronic spreadsheet to track expenses, including the types of formulas and visual aids you would employ.

Module 6: Computer Application Packages

Unit 4: Use of Presentation Packages (Microsoft PowerPoint)

Flow of the Unit

4.0 Objective
4.1 Presentation Package
4.2 Features of Presentation Package
4.3 Uses of Presentation Package
4.4 Identification of PowerPoint toolbar and its contents
4.5 Summary
4.6 Assessment questions
4.7 Reference

4.0 Objective

a. Identify the primary features and functions of major presentation application packages.
b. Create a visually appealing presentation using design principles and effective layout strategies.
c. Integrate multimedia elements into presentations to enhance engagement.

4.1 Presentation Package

A presentation package is a software package used to display information in the form of a slide show. It provides the resources necessary to give a professional presentation for meetings, lectures, speeches or other similar situations. It enables graphic images to be inserted and manipulated in slide show.

Examples of presentation package

- Microsoft PowerPoint
- Lotus Freelance graphics
- AstoundGem draw
- Lotus Show
- Kingsoft
- Adobe Persuasion

4.2 Features of Presentation Package

1. **Creation of slides:** slides titles are used to define the information on the slide as well as create a navigational outline for the presentation.

2. **Insertion of pictures:** Pictures can be inserted into the presentation by using a layout into the presentation by using a layout with a picture place holder shape, pictures can also be used as background for presentation graphics.
3. **Insertion of video and audio:** some presentation packages include objects such as sound clip animated graphics, video clips or other media objects, these objects are generally added to emphasize the content of the presentation or provide an alternative means of delivering information.
4. **Animation:** Customize animation is often added to a slide show. It can be used to delay the appearance of bullet points on the screen. The can help to keep audience focused on what is being presented.
5. **Slide show:** the slide show has different views, they are: From beginning or F5,from current slide or shift + F5
6. **Custom slide:** This creates or plays a custom slide show displays only the slides you select.
7. **Set up slide show:** It shows set up advance option such as kiosk mode
8. **Hide slide:** this will hide current slide from the presentation from showing during the full.
9. **Slide transition:** this can be set to govern how one moves from one slide to another
10. **Creation of graphics:** graphics images can be created using elements of type, imagery, colour and shape in order to communicate a message or idea visually.

Creation of organizational charts can be created from insert chart window e.g. column, line, pie, bar, area, xy (scatter, stock etc.)

4.3 Uses of Presentation Package

1. It is used to import other files such as Word and Excel into the PowerPoint slides
2. It allows the integration of multimedia such as using digital video and sound to enhance the presentation.
3. It gives easy upload of presentation to a server for web browsing
4. It assists educators to deliver course content to their students with imaginative and interactive.
5. Printing out slides, speaker's notes, audience handouts and outlines enables the
6. presenter and audience stay on track.

Microsoft PowerPoint is a presentation program that is incorporated in Microsoft Office suite package. It offers word processing, outlining drawing, graphing and presentation management tools

4.4 Identification of PowerPoint toolbar and its contents

Starting a presentation with Microsoft PowerPoint

There are two ways of starting Microsoft PowerPoint

- Click on start button, choose All Programs and click PowerPoint
- Double click on the icon of PowerPoint document and PowerPoint opens with the document already loaded.

A PowerPoint presentation consists of slide that can contain text, graphic, charts and other data types. When you load PowerPoint, you can start with a blank presentation or you can begin from a template or use the Auto Content Wizard.

- It is always advisable to start presentation with blank presentation because it is more flexible and enables one focus on the content first rather than the appearance. After choosing blank presentation
- Select layout from slide dialog box you can choose any one from the following options.
- Slide with titles and bullets
- Titles only
- Titles and clip Art etc.
- Click OK

Saving a Microsoft PowerPoint Presentation

Microsoft PowerPoint has two save commands (a) Save (b) Save As (both commands are in file menu)

When saving in PowerPoint, take the following cautions

- Naming convention
- Use short file name
- 8 letter words is preferred: The following characters cannot be used in naming a
- “ppt file”: @, $, = , ?, 1, etc.

- Alphabets and numbers can be used

Saving format

- ppt (default format)
- Pots
- JPEG
- ppsx (slide show)
- ppsm

A presentation is normally saved as name ".ppt" file type. However, PowerPoint show with the extension of name .pps is also a useful file type, so that your file can be able to run regardless of operating system. You can also create your own template and save it as pot file.

PowerPoint Views

PowerPoint has three major views

1. Normal View
2. Slide Sorter View
3. Slide Show View

1. **Normal View:** This consists of three panes such as slide pane, note pane and outline pane.
2. **Slide Sorter**: This allows one to add slides, move and delete slides. It displays multiple slides and enable one quickly change their order in the presentation.
3. **Slide Show:** This is a full screen display of each page in a presentation. It is called the preview. The three buttons at down-right of the window can be used to change the slide view.

Insert Slide Content

When you open Microsoft PowerPoint, the first item presentation is a slide. It contains a title (large box) and subtitle (small box) section.

Type "my first presentation" in the title and content section, type your name and class in the subtitle section. This is the first slide of the presentation.

Insert an additional slide with the "Title and Content" layout. As an example type definition of computer hardware in the title section, type the meaning of computer hardware in content section.

Insert a new slide with the title and content layout. In the title section, type “examples of computer hardware”. In the content section, hit the “Enter” key to ensure that each example has a bullet point.

Insert a new slide with title and content layout. In the title section type diagrams of computer hardware. Click in the content section and go to insert and clip art.

Double-click on any picture of computer hardware to insert it into the slide

Press the F5 key to view the presentation press the down arrow key to advance to the down arrow key to advance to the next slide.

4.5 Summary

Presentation application packages are software tools designed to create visual presentations, typically consisting of a series of slides. These applications enable users to convey information effectively through a combination of text, images, charts, and multimedia elements. Commonly used presentation software includes Microsoft PowerPoint, Google Slides, and Apple Keynote

4.6 Assessment Questions

1. Define presentation package
2. Mention five (5) examples of presentation
3. Mention six (6) features of presentation package and explain them
4. Mention three (3) uses of presentation package

Module 7: Computer Maintenance/Troubleshooting

Unit 1: Basic Concept of Computer Upgrading & Maintenance for PC

Flow of the Unit

1.0 Objective
1.1 Introduction
1.2 Overview
1.3 The Typical Hazards that Threaten the Regular Operation of a Computer
1.4 The Maintenance Procedure for PC
1.5 Summary
1.6 Assessment Question
1.7 Reference

1.0 Objective

a. Explain the importance of computer upgrading and maintenance for PCs.
b. Identify key hardware components that can be upgraded and describe the benefits of each.
c. Demonstrate basic maintenance tasks, including cleaning, software updates, and data backups.
d. Assess a PC's performance and recommend appropriate upgrades or maintenance tasks based on user needs.

1.1 Introduction

In today's technology-driven world, people depend almost fully on their computers, even for the simplest of tasks. Businesses maintain maximum performance through the use of the most up-to-date technologies; schools keep better management of students through the use of computers and even any person can benefit from these machines.

However, all this efficiency will be lost if computers are not maintained. The following points are just some of the ways to keep your computer clean for maximum performance.

1. When purchasing a computer remember to also purchase dust covers. As the name suggests these will help prevent the build-up of dust on your computer's monitor, central processing unit (CPU), keyboard and mouse.
2. When considering a location for the computer in your home or office, place it in an area that is cool - an air-conditioned room is preferable - or in an area that will not accommodate the easy transmittal of dust to the computer, although this cannot be prevented. Placing the

computer near an open window is not advisable, as this will make the computer most vulnerable to the elements, such as wind, dust and rain.

3. If one is serious about maintaining his computer for optimal performance then he should also seriously consider cleaning the computer on a regular basis. This includes cleaning the monitor, CPU, keyboard and mouse. The vacuuming of the inside of the CPU should also be done to eliminate the build-up of dust on valuable hardware. To undertake this task, one should utilize the appropriate tools and have the proper understanding of what is to be done. If this is not clear, then one should utilize the services of a trained technician.
4. Maintaining the optimum performance of one's computer also includes managing the files on the computer's hard-drive. Keeping files over two years old only means slowing down the speed of that computer. Once a file has been used and will not be used or needed for now, then that file can be deleted or saved onto a floppy disk and removed from the computer's hard-drive. Once the diskette is properly labeled concerning its contents, then that file can be found again. The computer will now have more space for other important documents.
5. Essential to the maintenance of a computer is the utilization of a good virus protection and detection software. Viruses are made daily and without the appropriate software can cause disastrous consequence for a computer's hard-drive.

If you follow these simple guidelines, which are by no means exhaustive, then you will be sure that your computer will run at its best.

1.2 Overview

Computer maintenance refers to the physical processes of upkeep of the peripherals. Maintenance activities like regular brushing, dusting, vacuum cleaning etc. are the important and mostly ignored preventive measures.

Regular maintenance generally takes care of most of the problems especially those of data loss or corruption. So, it should be given due importance.

Troubleshooting is isolating the source of a problem and fixing it. In the case of computer systems, the term troubleshoot is usually used when the problem is suspected to be hardware related. If the

problem is known to be in software, the term debug is more commonly used. Although troubleshooting covers both hardware and software.

Hardware troubleshooting includes removing the problems when the hardware devices as mouse, monitor, printer, modem etc. malfunction.

Software troubleshooting includes removing problems encountered while working with Operating System. It also includes the most threatened problem these days, viruses.

1.3 The Typical Hazards that Threaten the Regular Operation of a Computer

Computers are susceptible to various hazards that can disrupt their regular operation and potentially cause damage. Understanding these hazards is crucial for maintaining the functionality and longevity of your computer system. Here are some typical hazards that can threaten the regular operation of a computer:

1. **Electrical Surges and Outages:** Sudden power surges, spikes, or electrical outages can damage computer components, corrupt data, and lead to unexpected shutdowns. To protect against these hazards, consider using surge protectors and uninterruptible power supplies (UPS).
2. **Heat and Overheating:** Computers generate heat during operation, and if not adequately managed, excessive heat can damage internal components like the CPU and graphics card. Proper ventilation and cooling systems are essential to prevent overheating.
3. **Dust and Debris:** Dust and debris can accumulate inside a computer, clogging fans and heat sinks, leading to overheating and reduced performance. Regular cleaning of your computer's interior is essential to mitigate this hazard.
4. **Physical Damage:** Accidental bumps, drops, or spills can cause physical damage to your computer, such as cracked screens, damaged ports, or dislodged components. Using protective cases and being cautious with your device can help prevent physical damage.
5. **Malware and Viruses:** Malicious software, including viruses, malware, and ransomware, can infect your computer, compromise data, and disrupt its operation. Regularly updated antivirus software and safe online browsing practices can mitigate this risk.

6. **Software Glitches and Crashes:** Software issues, such as bugs, glitches, and incompatible programs, can lead to system crashes and instability. Keeping your operating system and software up to date can help prevent these problems.
7. **Data Loss:** Data loss can occur due to various factors, including hardware failures, accidental deletion, and software errors. Regularly backing up your data is essential to safeguard against this hazard.
8. **Network Threats:** If connected to the internet, your computer is vulnerable to network-based threats like hacking, phishing, and data breaches. Using firewalls, strong passwords, and staying vigilant against online threats can protect your computer.
9. **Hardware Failures:** Components like hard drives, RAM, and power supplies can fail over time or due to manufacturing defects. Regular monitoring and periodic hardware checks can help detect and address potential issues before they disrupt your computer's operation.
10. **Software and Operating System Updates:** While updates are essential for security and performance improvements, they can sometimes introduce compatibility issues or bugs that affect your computer's regular operation. Ensuring that you keep up with updates and addressing any post-update issues promptly can help mitigate this risk.
11. **User Errors:** Human errors, such as improper handling of files, accidental deletions, and misconfigurations, can lead to data loss and system problems. Educating users and practicing safe computing habits can reduce the likelihood of user-related hazards.
12. **Environmental Factors:** Environmental hazards, such as extreme temperatures, humidity, and exposure to water or dust, can impact a computer's operation and lifespan. Storing and using your computer in a suitable environment can help prevent damage from these factors.

Understanding and proactively addressing these typical hazards can significantly improve the reliability and longevity of your computer system while ensuring that it continues to operate smoothly for your needs.

1.4 The Maintenance Procedure for PC

Performing regular maintenance on your PC is essential to keep it running smoothly and extend its lifespan. Here's a step-by-step procedure for PC maintenance:

Before You Begin:

- Ensure you have the necessary tools, including a screwdriver, canned air (compressed air), microfiber cloths, and cleaning solution for screens and surfaces.
- Work in a clean, well-ventilated, and static-free area.
- Make sure your PC is powered off and unplugged from the electrical outlet. Step 1: Exterior Cleaning

Sep 1: Exterior Cleaning

- Gently wipe the exterior of your PC case using a microfiber cloth to remove dust and fingerprints.
- Use a screen cleaning solution (or a mixture of distilled water and isopropyl alcohol in a 1:1 ratio) and a microfiber cloth to clean the monitor screen and other external surfaces.

Step 2: Interior Cleaning

- Open the PC case by removing the side panel (typically secured with screws).
- Use canned air to blow out dust and debris from the interior components, such as the CPU
- cooler, GPU, motherboard, and fans.
- Pay special attention to the CPU cooler and GPU heatsinks, as they tend to accumulate dust. Hold fans in place while cleaning to prevent them from spinning.
- Clean the power supply unit (PSU) fan if your PSU has an intake fan. Do not open the PSU; simply blow air into its intake vent.
- Remove dust buildup on RAM modules and other components using canned air.

Step 3: Cable Management

- Check cable connections to ensure they are secure.
- Neatly arrange and secure cables using cable ties or Velcro straps to improve airflow and reduce cable clutter.

Step 4: Software Maintenance

- Run Windows or your operating system's built-in disk cleanup utility to remove temporary files and free up disk space.
- Regularly update your operating system and drivers to ensure security and performance.
- Uninstall unused or unnecessary software and applications to declutter your system.
- Install and run reputable antivirus and anti-malware software to scan and remove threats.

- Regularly back up your important data to an external drive or cloud storage to prevent data loss.

Step 5: Hardware Health Check

- Use system monitoring software to check the temperature, fan speed, and overall health of your PC's components. Address any overheating or performance issues accordingly.
- Test the functionality of your backup power supply (UPS) if you have one.
- Check the condition of your storage drives (HDD or SSD) using disk diagnostic tools to identify any potential issues.

Step 6: Security and Privacy

- Ensure your operating system has a firewall enabled for added security.
- Review your privacy setÝngs and consider using a virtual private network (VPN) for online security.

Step 7: Backup

- Regularly back up your important files, documents, and data to an external drive or cloud storage to prevent data loss.

Step 8: Regular Maintenance Schedule

- Create a maintenance schedule and perform these tasks periodically, depending on your computer's usage and environment. Quarterly or semi-annually is a good starting point.

By following these steps and maintaining a regular schedule, you can keep your PC in good working condition, minimize the risk of hardware failures, and ensure a smoother and more reliable computing experience.

1.5 Summary

Computer upgrading and maintenance are essential practices for ensuring the optimal performance, longevity, and reliability of personal computers (PCs). Upgrading involves enhancing a computer's hardware or software components to improve functionality, speed, or capabilities. Common upgrades include adding more RAM, replacing hard drives with solid-state drives (SSDs), upgrading graphics cards, and installing updated software

1.6 Assessment Questions

1. What are three common hardware upgrades for a PC, and how does each upgrade improve system performance?
2. Describe the steps you would take to perform a basic cleaning and maintenance check on a desktop PC. Include safety precautions.
3. Compare the advantages and disadvantages of upgrading to an SSD versus increasing RAM. In what scenarios would each upgrade be most beneficial?
4. A user reports that their PC is running slowly and frequently crashes. What troubleshooting steps would you recommend, and what upgrades might help improve the situation?

Module 7: Computer Maintenance/Troubleshooting

Unit 2: PC Limitation & Scope for Upgrading

Flow of the Unit

2.0 Objective
2.1 Introduction
2.2 The Need for PC Upgrade
2.3 The Technical Specification for PC Upgrading
2.4 PC Limitation and Scope for Upgrading
2.5 Summary
2.6 Assessment Question
2.7 Reference

2.0 Objective

a. Identify key limitations that affect the upgradeability of a PC.
b. Explain the technical specifications relevant to various PC components.
c. Assess a PC's existing hardware to determine upgrade potential and compatibility.
d. Develop a plan for upgrading specific components based on user needs and budget constraints..

2.1 Introduction

A PC upgrade refers to the process of enhancing or improving the performance, capabilities, or features of a personal computer (PC) by replacing or adding hardware or software components. PC upgrades can be undertaken for various reasons, including increasing system speed, expanding storage capacity, enhancing graphics capabilities, improving overall system reliability, or enabling compatibility with newer software or technologies. Upgrades can involve components such as the CPU, RAM, graphics card, storage drives (HDD or SSD), power supply unit (PSU), motherboard, or peripherals like monitors, keyboards, and mice. The goal of a PC upgrade is to extend the useful life of the computer, meet changing computing needs, or take advantage of new technology advancements without the need for a complete system replacement.

2.2 The Need for PC Upgrade

The need for PC upgrades arises from various factors, all aimed at improving or maintaining the computer's performance, functionality, and compatibility with modern software and hardware. Here are some key reasons why upgrading a PC can be necessary:

1. ***Improved Performance:*** One of the primary reasons for upgrading a PC is to enhance its performance. Over time, software applications and operating systems become more

demanding, requiring greater processing power, memory, and storage capacity. Upgrading components like the CPU, RAM, or SSD can significantly boost a computer's speed and responsiveness, allowing it to handle tasks more eﬁciently.

2. ***Software Requirements:*** Newer software and operating systems often have higher system requirements. If your PC can't meet these requirements, it may struggle to run newer applications or receive updates. Upgrading your hardware ensures that your PC remains compatible with the latest software, improving its usability and security.
3. ***Gaming and Graphics:*** Gamers often need to upgrade their PCs to enjoy the latest video games with high-quality graphics and smooth gameplay. A more powerful graphics card, along with sufficient RAM and a capable CPU, can make a significant difference in gaming performance.
4. ***Multimedia Production:*** If you're involved in tasks like video editing, 3D rendering, or music production, upgrading your PC can be essential. These tasks demand powerful processors, ample RAM, and dedicated graphics cards to handle the complexity of multimedia production software eﬁciently.
5. ***Storage Capacity***: As files, photos, videos, and applications accumulate over time, your storage needs may exceed your current hard drive or SSD capacity. Upgrading to a larger storage drive or adding additional drives can provide the necessary space and improve overall system performance.
6. ***Compatibility:*** Older PCs may struggle with newer peripherals and accessories due to outdated ports and connectors. Upgrading or adding expansion cards, such as USB 3.0 or Thunderbolt cards, can ensure compatibility with modern devices.
7. ***Extended Lifespan:*** Upgrading specific components, such as the power supply unit or cooling system, can extend the overall lifespan of your PC. This can be a cost-effective alternative to purchasing a completely new system.
8. ***Energy Eﬁciency:*** Newer components are often more energy-eﬁcient, resulting in lower electricity bills and reduced environmental impact. Upgrading your PC can be a step toward reducing your carbon footprint.
9. ***Security:*** Older PCs may lack the necessary hardware security features to protect against modern threats. Upgrading to a newer system with built-in security technologies, like hardware- based encryption or biometric authentication, can enhance your data security.

10. ***Future-Proofing:*** Investing in certain upgrades can future-proof your PC to some extent, allowing it to remain relevant and functional for a more extended period. This can save you money in the long run by delaying the need for a full PC replacement.
11. ***Personalized Needs:*** PC upgrades can be tailored to your specific needs and preferences. Whether you want a silent PC, a compact form factor, or a system optimized for a particular task, upgrading allows you to customize your PC to suit your requirements.

In conclusion, the need for PC upgrades is driven by the desire for improved performance, enhanced functionality, and compatibility with modern software and hardware. Whether you're a gamer, a professional, or a casual user, upgrading your PC can help you get the most out of your computer and adapt it to meet your evolving needs. It's essential to assess your PC's current state and your goals before deciding on specific upgrades to ensure that your investment aligns with your computing requirements.

2.3 The Technical Specification of PC Upgrading

Hardware upgrading is the process of replacing or adding components to a computer system to improve its performance, capabilities, or functionality. Here is a step-by-step guide to help you understand the process of hardware upgrading:

1. Determine Your Needs:

- Before you start upgrading, assess your specific needs. Are you looking to boost gaming performance, improve multitasking capabilities, or enhance storage capacity? Understanding your goals will guide your upgrade decisions.

2. Compatibility Check:

- Ensure that the new hardware you intend to install is compatible with your existing system. Check factors like motherboard compatibility, power supply requirements, physical space inside the case, and compatibility with your operating system.

3. Backup Data:

- Before any hardware upgrades, back up your data. This precaution ensures that you won't lose important files or setÝngs in case something goes wrong during the upgrade process.

4. Prepare the Workspace:

- Find a clean, well-lit, and static-free workspace to work on your computer. Ground yourself by wearing an anti-static wristband or touching a grounded metal surface to prevent electrostatic discharge (ESD) that can damage sensitive components.

5. Gather Necessary Tools:

- You'll need a set of tools, including screwdrivers, pliers, and cable ties, to help with the disassembly and reassembly of your computer. 6. Turn Off and Unplug:
- Power off your computer and unplug it from the electrical outlet. Also, disconnect any external devices and cables.

7. Open the Case:

- Depending on your computer case, you may need to remove screws or use a latch to
- open it. Carefully remove the case panel to access the internal components.

8. Handle Components Carefully:

- When handling hardware components, avoid touching sensitive parts (e.g., connectors, pins, or circuitry). Hold components by their edges or non-sensitive areas.

9. Install or Replace Components:

Depending on your upgrade goals, perform the following actions:

- RAM Upgrade: Align the RAM module with the slot and gently push it in until it clicks into place.
- Graphics Card Upgrade: Remove the old card (if present) by releasing any retaining clips or screws. Insert the new graphics card into the appropriate PCIe slot and secure it with screws if necessary.
- Storage Upgrade: Disconnect the power and data cables from the old drive. Install the new drive, ensuring it's securely connected. For SSDs or HDDs, you may need to mount them in drive bays using screws.
- CPU Upgrade: This is a more complex upgrade. Consult your motherboard manual for detailed instructions on removing the old CPU and installing the new one.
- Cooling System Upgrade: Upgrading the CPU cooler may require removing the old cooler, cleaning the CPU surface, applying thermal paste, and attaching the new cooler according to its instructions.

- Power Supply Upgrade: Disconnect all power cables from the motherboard and components, remove the old power supply, and install the new one. Reconnect all cables, ensuring they are properly routed and secured.

10. Cable Management:

- Neatly route and secure cables to ensure good airflow and prevent them from obstructing fans or components. 11. Close the Case:
- Carefully place the case panel back on, secure it with screws or latches, and ensure it's properly seated.

12. Power On and Test:

- Reconnect all cables and devices, plug in the power cord, and power on your computer. Check for any error messages, unusual sounds, or hardware issues. If everything appears normal, proceed to the next step.

13. Install Drivers and Update BIOS:

- Depending on the hardware you upgraded, you may need to install new drivers and update your motherboard's BIOS to ensure proper functionality. 14. Test and Monitor:
- After completing the upgrade, monitor your computer's performance and stability. Ensure that temperatures remain within safe limits, especially for CPU and GPU upgrades.

15. Dispose of Old Components:

- Properly dispose of or recycle old hardware components according to local regulations.

Remember that hardware upgrading can vary significantly depending on the specific components and the complexity of the upgrade. Always consult the documentation and instructions provided with your new hardware and your computer's motherboard manual for guidance tailored to your system. If you're unsure about any step of the process, consider seeking assistance from a professional technician.

2.4 PC Limitation and Scope for Upgrading

Upgrading is a term used to describe updating a software program or adding a new hardware. Software upgrade allows a user to get the latest version of a software program at a discounted price and not have to purchase the full product. For example, a user running Microsoft Windows 95 could purchase the Microsoft Windows 98 upgrade for a low price when compared to the full

version of Windows 98. Below is a few reasons and benefits of upgrading your software products to the latest version.

A hardware upgrade often involves removing an old hardware device and replacing it with a new hardware device. For example, replacing an 8MB PCI video card with a 32MB AGP video card would be considered an upgrade. A hardware upgrade such as a memory upgrade may not require a user to remove the memory from the computer because of the availability of additional expansion slots.

Below are a few reasons and benefits a user should expect to see when upgrading a hardware device.

1. ***Performance increase.*** The majority of the hardware upgrades performed are done to increase the performance of the computer.
2. ***Capacity increase.*** Users may upgrade or add a new device to increase the overall capacity of the computer. For example, adding a new hard drive to allow the computer to store more information. Or increase the memory to increase the ability of what programs can be opened and also at the same time increase the performance.
3. **Compatibility.** A user may upgrade one or more components in their computer to be able to run or use a software program as long as the power supply is plugged in.

However, because you are strongly urged to protect yourself by unplugging the power supply ac, do not rely on the chassis to discharge you. Grounding also prevents a serious shock or fire hazard if ac should come in contact with the metal case.

The enclosure also limits the PC's expansion capacity. Average-sized desktop enclosures typically offer room for motherboards with 6 to 8 expansion slots, and provide space.

3.8 Summary

Understanding the limitations and scope of upgrading a PC is crucial for optimizing its performance and ensuring it meets the user's needs. Every PC has inherent limitations based on its design, components, and compatibility.

3.9 Assessment Questions

1. What are three limitations that can affect a PC's upgrade potential, and how do they influence the decision to upgrade?

2. Given a list of hardware specifications for a specific PC, determine which components can be upgraded and suggest possible upgrades along with their benefits.
3. Compare the upgrade potential of a desktop PC versus a laptop. What unique challenges do each present regarding upgrades?
4. A user wants to improve gaming performance on their PC but has a limited budget. Analyze their current specifications and recommend the best upgrade option(s) while justifying your choices.

Module 7: Computer Maintenance/Troubleshooting

Unit 2: Solution to Common Computer Problems

Flow of the Unit

3.0 Objective
3.1 How to replace the computer's case
3.2 How to Replace the Computer's Power Supply Unit
3.3 How to Replace the Computer's Motherboard
3.4 How to Replace the Computer's CPU
3.5 How to Replace the Computer's Mass Storage
3.6 How to Replace the Computer Display Unit
3.7 How to Replace the Computer Keyboard and Mouse
3.8 Summary
3.9 Assessment Questions
3.9 Reference

3.0 Objective

a. Identify common computer problems and their symptoms.
b. Explain effective troubleshooting steps for each identified problem.
c. Demonstrate the ability to resolve specific computer issues using appropriate tools and methods.
d. Evaluate the importance of preventive maintenance to minimize the occurrence of these problems.

3.1 How to Replace the Computer's Case

Replacing a computer case involves transferring all the internal components from your existing case to a new one. It's a task that requires careful handling of your computer's hardware. Here's a step-by-step guide on how to replace a computer case:

Before You Begin:

- Ensure you have a new computer case that is compatible with your motherboard's form factor (e.g., ATX, MicroATX).
- Make sure you have the necessary tools: screwdrivers, pliers, cable ties, and an anti-static wristband.
- Back up your data to ensure you don't lose any important files during the transfer.
- Work in a clean, well-lit, and static-free area to avoid damaging sensitive components.

Step 1: Power Off and Unplug

1. Turn off your computer and unplug it from the electrical outlet.
2. Disconnect all external cables and devices from the old case, including the power cord, monitor, keyboard, mouse, and any USB devices.

Step 2: Open the Old Case:

- Depending on the design of your old case, remove screws or use latches to open it.
- Some cases have removable side panels, while others may have a hinged design.
- Carefully remove the side panel to access the internal components.

Step 3: Disconnect Internal Cables:

- Disconnect all internal cables from the motherboard and components.
- This includes the power supply cables, data cables (e.g., SATA cables for hard drives and SSDs), and front-panel connectors (e.g., power button, reset button, and LED indicators).
- ***Note*** the positions and connections of these cables, which will make it easier to reconnect them in the new case.

Step 4: Remove Components:

- Begin by removing the expansion cards (e.g., graphics card, sound card) by unscrewing them from the case's rear bracket and gently releasing any retaining clips.
- Carefully disconnect the power cables from your hard drives, SSDs, optical drives, and any other components.
- Unscrew the motherboard from the case by removing the screws securing it to the motherboard tray.
- Ensure you have removed all screws holding the motherboard in place. Gently lift the motherboard out of the case and place it on an anti-static surface.

Step 5: Transfer Components to the New Case:

- Place the new case in your workspace and open it according to the manufacturer's instructions.
- Install the motherboard into the new case, aligning it with the standoffs (small raised metal studs) in the case. Secure it with screws. Reconnect all the internal cables, ensuring they are properly routed and connected to their respective ports on the motherboard and components.
- Install the expansion cards into the appropriate PCIe slots and secure them with screws. Reconnect the power cables to your hard drives, SSDs, and any other components. Double-check all connections to ensure they are secure and properly seated.

Step 6: Cable Management:

- Neatly route and secure cables using cable ties or Velcro straps to ensure good airflow and prevent cable clutter.

Step 7: Close the New Case:

- Carefully close the new case according to the manufacturer's instructions, securing it with screws or latches.

Step 8: Power On and Test:

- Reconnect all external cables and devices to your computer.
- Plug in the power cord and turn on your computer.
- Check for any error messages, unusual
- Sounds, or hardware issues.
- If everything appears normal, your computer is ready to use in its new case. Remember that this process can vary slightly depending on the design and features of your old and new computer cases.

Always consult the documentation provided with your cases and your motherboard manual for specific instructions. If you're uncertain about any step, consider seeking assistance from a professional technician.

3.2 How to Replace the Computer's Power Supply Unit

Replacing a computer power supply unit (PSU) is a relatively straightforward process, but it does involve working with electrical components, so it's important to take precautions. Here's a step-by-step guide on how to replace a computer power supply:

Before You Begin:

- Ensure you have a replacement power supply unit (PSU) that is compatible with your computer's form factor and has the necessary wattage to support your components.
- Make sure you have the necessary tools, including a screwdriver.
- Work in a clean, well-lit, and static-free area to avoid damaging sensitive components.
- Disconnect your computer from the electrical outlet and all external devices before starting.

Step 1: Power Off and Unplug

1. Turn off your computer and unplug it from the electrical outlet.

2. Disconnect all external cables and devices from the computer, including the power cord, monitor, keyboard, mouse, and any USB devices.

Step 2: Open the Computer Case:

- Depending on your computer's case design, remove screws or use latches to open it. Some cases have removable side panels, while others may have a hinged design.
- Carefully remove the side panel to access the internal components.

Step 3: Disconnect Cables:

- Locate the old power supply unit (PSU) inside the case.
- Disconnect all power cables coming from the PSU to your motherboard and components.
- This includes the 24-pin ATX connector, CPU power connector (usually 4 or 8 pins), SATA power cables for hard drives and SSDs, and any PCIe power connectors for graphics cards.
- ***Note*** the positions and connections of these cables, which will make it easier to reconnect them to the new PSU.

Step 4: Remove the Old PSU:

- Locate the screws securing the old PSU to the case, typically at the back of the case.
- Carefully remove these screws, ensuring the PSU doesn't fall as you do so.
- Once the screws are removed, gently slide the old PSU out of its mounting bracket.

Step 5: Install the New PSU

- Place the new PSU into the same mounting bracket or area where the old PSU was located. Secure the new PSU to the case by fastening the screws in the same positions as the old PSU.
- Make sure the PSU's fan is facing the correct direction to allow for proper airflow.
- Typically, the fan should face down, drawing in cool air from beneath the case and expelling hot air out the back.

Step 6: Reconnect Cables:

- Begin reconnecting the power cables to your motherboard and components. Start with the 24-pin ATX connector, followed by the CPU power connector, SATA power cables, and any PCIe power connectors for graphics cards.
- Ensure these connections are secure and properly seated.

Step 7: Cable Management:

- Neatly route and secure cables using cable ties or Velcro straps to ensure good airflow and prevent cable clutter.

Step 8: Close the Case:

- Carefully close the computer case according to the manufacturer's instructions, securing it with screws or latches.

Step 9: Power On and Test:

- Reconnect all external cables and devices to your computer. Plug in the power cord and turn on your computer. Check for any error messages, unusual sounds, or hardware issues.
- If everything appears normal, your computer should now be powered by the new PSU.
- Always consult the documentation provided with your PSU and your computer case for specific instructions and considerations.
- If you're uncertain about any step or have any doubts, consider seeking assistance from a professional technician.

Additionally, ensure that the wattage of the new PSU is sufficient to power all your components, including any future upgrades you may plan.

3.3 How to Replace the Computer's Motherboard

Replacing a computer motherboard is a more complex task than some other hardware upgrades because it involves disassembling and reassembling the entire computer. It also requires careful handling of sensitive components. Here's a step-by-step guide on how to replace a computer motherboard:

- Ensure you have a replacement motherboard that is compatible with your existing components (CPU, RAM, GPU, etc.) and fits your computer case's form factor.
- Make sure you have the necessary tools, including screwdrivers.
- Work in a clean, well-lit, and static-free area to avoid damaging sensitive components.
- Back up your data to ensure you don't lose any important files during the motherboard replacement.

Step 1: Power Off and Unplug

1. Turn off your computer and unplug it from the electrical outlet.

2. Disconnect all external cables and devices from the computer, including the power cord, monitor, keyboard, mouse, and any USB devices.

Step 2: Open the Computer Case:

- Depending on your computer case design, remove screws or use latches to open it. Some cases have removable side panels, while others may have a hinged design.
- Carefully remove the side panel to access the internal components.

Step 3: Document and Disconnect Cables:

- Document the positions and connections of all cables connected to your motherboard. T
- his includes power connectors, data cables (SATA, USB, etc.), and front-panel connectors (power button, reset button, LEDs, etc.). Taking photos or notes can be helpful.
- Disconnect all these cables from the motherboard.

Step 4: Remove Components:

- Remove any expansion cards (graphics card, sound card, etc.) from the motherboard. Unscrew them from the case's rear bracket and gently release any retaining clips.
- Disconnect any RAM modules by pressing down on the retention clips at the sides and gently removing them. Disconnect any CPU cooler fan or liquid cooling system.
- Remove the screws securing the motherboard to the case. Ensure you have removed all screws. Carefully lift the old motherboard out of the case and place it on an anti-static surface.

Step 5: Install the New Motherboard:

- Place the new motherboard into the case, aligning it with the standoffs (small raised metal studs) in the case. Secure it with screws, ensuring it's properly positioned.
- Reinstall the RAM modules by aligning them with the slots and gently pressing down until they click into place.
- Reinstall the CPU and CPU cooler, ensuring that you've applied thermal paste if necessary and that the cooler is properly attached.
- Reinstall any expansion cards into their respective PCIe slots and secure them with screws.
- Connect all the cables back to the motherboard, following the documentation or notes you took earlier. Be especially careful with the front-panel connectors, which control the power button, reset button, LEDs, and more.

Step 6: Cable Management:

- Neatly route and secure cables using cable ties or Velcro straps to ensure good airflow and prevent cable clutter.

Step 7: Close the Case:

- Carefully close the computer case according to the manufacturer's instructions, securing it with screws or latches.

Step 8: Power On and Test:

- Reconnect all external cables and devices to your computer.
- Plug in the power cord and turn on your computer. Check for any error messages, unusual sounds, or hardware issues.
- If everything appears normal, your computer should now be running on the new motherboard.
- Remember that this process can vary slightly depending on the design and features of your old and new motherboards. Always consult the documentation provided with your motherboard and your computer case for specific instructions and considerations. If you're uncertain about any step or have any doubts, consider seeking assistance from a professional technician.

3.4 How to Replace the Computer's CPU

Replacing a computer's Central Processing Unit (CPU) is a delicate process, as it involves handling sensitive components and ensuring compatibility with other hardware. Here's a step-by-step guide on how to replace a CPU:

Before You Begin:

- Ensure you have a compatible replacement CPU that fits your motherboard socket type.
- Make sure you have the necessary tools, including thermal paste, a screwdriver, and an anti-static wristband.
- Work in a clean, well-lit, and static-free area to avoid damaging sensitive components.
- Back up your data to ensure you don't lose any important files during the CPU replacement.

Step 1: Power Off and Unplug

1. Turn off your computer and unplug it from the electrical outlet.

2. Disconnect all external cables and devices from the computer, including the power cord, monitor, keyboard, mouse, and any USB devices.

Step 2: Open the Computer Case

- Depending on your computer case design, remove screws or use latches to open it. Some cases have removable side panels, while others may have a hinged design.
- Carefully remove the side panel to access the internal components.

Step 3: Locate and Access the CPU:

- Locate the CPU socket on the motherboard. It's usually located near the center and is covered by a protective plate with a lever or latch.
- Carefully release the latch or lever to unlock the CPU socket.

Step 4: Remove the Old CPU:

- Gently lift the old CPU out of the socket by grasping it on the sides. Be sure to lift it straight up to avoid bending the pins.
- Place the old CPU in an anti-static bag or container for safekeeping, especially if you plan to keep it as a spare.

Step 5: Install the New CPU:

- Carefully remove the new CPU from its packaging, handling it by the sides and avoiding contact with the pins.
- Align the notches or markers on the CPU with the corresponding markers on the CPU socket to ensure proper orientation.
- Gently lower the new CPU into the socket, making sure it seats properly.
- Secure the CPU in place by locking the lever or latch back into its closed position. This should require little to no force; if it's difficult to close, double-check the CPU's alignment.

Step 6: Apply Thermal Paste:

- If you're reusing the existing CPU cooler, clean off the old thermal paste from the cooler and CPU heat spreader with isopropyl alcohol and a lint-free cloth.
- Apply a small amount of fresh thermal paste (usually a pea-sized dot) to the center of the CPU heat spreader. You can spread it evenly if necessary but don't overdo it.

Step 7: Reinstall the CPU Cooler:

- Carefully reattach the CPU cooler to the motherboard, ensuring it's aligned with the screw holes.

- Secure the cooler in place by fastening the screws or clips, following a diagonal pattern to ensure even pressure.

Step 8: Cable Management and Closing the Case:

- Neatly route and secure any cooler or fan cables to ensure good airflow and prevent cable clutter.
- Carefully close the computer case according to the manufacturer's instructions, securing it with screws or latches.

Step 9: Power On and Test:

- Reconnect all external cables and devices to your computer.
- Plug in the power cord and turn on your computer. Check for any error messages, unusual sounds, or hardware issues.
- If everything appears normal, your computer should now be running on the new CPU.
- Remember that this process can vary slightly depending on your motherboard and CPU cooler design. Always consult the documentation provided with your CPU and motherboard for specific instructions and considerations. If you're uncertain about any step or have any doubts, consider seeking assistance from a professional technician.

3.5 How to Replace the Computer's Mass Storage

Replacing a computer's mass storage, such as a hard drive (HDD) or solid-state drive (SSD), is a relatively straightforward process. Here's a step-by-step guide on how to replace your computer's mass storage:

Before You Begin:

- Ensure you have a compatible replacement mass storage drive (HDD or SSD) that fits your computer's drive bay and connectors.
- Make sure you have the necessary tools, including a screwdriver.
- Back up your data to ensure you don't lose any important files during the replacement.

Step1: Power Off and Unplug

1. Turn off your computer and unplug it from the electrical outlet.
2. Disconnect all external cables and devices from the computer, including the power cord, monitor, keyboard, mouse, and any USB devices.

Step 2: Open the Computer Case:

- Depending on your computer case design, remove screws or use latches to open it. Some cases have removable side panels, while others may have a hinged design.
- Carefully remove the side panel to access the internal components.

Step 3: Locate and Access the Mass Storage Drive:

- Identify the existing mass storage drive (HDD or SSD) you want to replace.
- The drive is typically mounted in a drive bay. Locate it and remove any screws or fasteners holding it in place.

Step 4: Disconnect and Remove the Old Drive:

- Carefully disconnect any data and power cables connected to the old drive.
- If the drive is secured in a drive caddy or tray, remove it by unscrewing any mounting screws.
- Gently slide the old drive out of its bay or tray.

Step 5: Install the New Drive:

- Remove the new mass storage drive from its packaging and attach it to any mounting brackets or trays that came with your case or drive.
- Carefully slide the new drive into the same drive bay or tray from which you removed the old drive.

Step 6: Connect Data and Power Cables:

- Reconnect the data and power cables to the new drive, ensuring they are securely connected. The data cable is typically a SATA cable, and the power cable comes from the power supply unit (PSU).

Step 7: Secure the New Drive:

- If the new drive uses mounting screws or brackets, secure it in place using the same screws you removed from the old drive or any provided with the case.
- Make sure the new drive is firmly seated in the bay or tray.

Step 8: Cable Management:

- Neatly route and secure any cables to ensure good airflow and prevent cable clutter.

Step 9: Close the Case:

- Carefully close the computer case according to the manufacturer's instructions, securing it with screws or latches.

Step 10: Power On and Test:

- Reconnect all external cables and devices to your computer.
- Plug in the power cord and turn on your computer. Check for any error messages or unusual
- sounds.
- If everything appears normal, your computer should now recognize and use the new mass storage drive.

Step 11: Install an Operating System or Restore Data (if necessary):

- If you've replaced the drive that contains your operating system, you may need to reinstall the OS using installation media (e.g., a USB drive or DVD) and restore your data from your backup.
- Remember that this process can vary slightly depending on your specific computer case and drive mounting system. Always consult the documentation provided with your case and drives for specific instructions and considerations. If you're uncertain about any step or have any doubts, consider seeking assistance from a professional technician.

3.6 How to Replace the Computer Display Unit

Replacing a computer display unit, typically a monitor, is a relatively straightforward process. Here's a step-by-step guide on how to replace a computer monitor:

Before You Begin:

- Ensure you have a compatible replacement monitor that fits your needs and has the necessary connections for your computer.
- Make sure you have the necessary tools, including a screwdriver or any required tools for your specific monitor.
- If you're replacing a desktop monitor, turn off your computer and unplug it from the electrical outlet.
- Disconnect all cables and devices from the existing monitor, including the power cord, video cable (HDMI, DisplayPort, VGA, etc.), keyboard, and mouse.

Step 1: Remove the Old Monitor

1. If you're replacing a desktop monitor, locate the screws or fasteners that secure the monitor to the monitor stand or arm.
2. Carefully unscrew or unfasten these screws to detach the old monitor from its stand or arm.

3. Gently lift the old monitor off the stand or arm and set it aside.

Step 2: Prepare the New Monitor:

- Remove the new monitor from its packaging and place it on a clean, flat surface.
- If the new monitor has a separate stand or mount, assemble it according to the manufacturer's instructions.
- If the monitor requires any additional components or brackets for mounting, ensure they are properly attached.

Step 3: Connect Cables:

- Connect the appropriate video cable (HDMI, DisplayPort, VGA, etc.) to the new monitor and to your computer's video output port. Ensure a secure connection.
- If the monitor requires external power, connect the power cable to the monitor and plug it into an electrical outlet or surge protector.

Step 4: Position the New Monitor:

- Carefully place the new monitor on your desk or mount it to the stand or arm, following the manufacturer's instructions.
- Ensure the monitor is level and secure in its position.

Step 5: Power On and Test:

- Turn on your computer and the new monitor.
- Check that the new monitor displays the computer's video output correctly.
- Adjust the monitor's setÝngs, such as resolution, brightness, and contrast, to your liking.

Step 6: Dispose of the Old Monitor:

- If the old monitor is no longer needed, consider recycling it or disposing of it in accordance with your local regulations. Many electronics retailers and recycling centers accept old monitors for proper disposal.

Please note that the process for replacing a laptop's built-in display is more complex and typically requires professional expertise due to the intricate nature of laptop hardware. If you're looking to replace a laptop display, it's advisable to consult a professional technician or contact the laptop manufacturer's service center for assistance.

3.7 How to Replace the Computer Keyboard and Mouse

Replacing a computer keyboard and mouse is a straightforward process. Here's a step-by-step guide on how to do it:

Replacing the Keyboard: Before You Begin:

- Make sure you have a compatible replacement keyboard that uses the same connection type (USB, wireless, etc.) as your existing setup.
- Ensure you have a clean workspace with enough room to work comfortably.
- Turn off your computer. Step 1: Remove the Old Keyboard:

Step 1.

1. If you have a wired keyboard, unplug it from the USB port.
2. If you have a wireless keyboard with a USB receiver, unplug the receiver.
3. For laptops, skip to "Replacing the Mouse" section below, and then proceed to Step 4 for connecting the new keyboard.

Step 2: Connect the New Keyboard:

- If you have a wired keyboard, simply plug it into an available USB port on your computer.
- If you have a wireless keyboard, follow the manufacturer's instructions to connect it to your computer.
- This usually involves turning on the keyboard and pressing a sync button or entering a code, depending on the model.

Step 3: Test the New Keyboard:

- Turn on your computer.
- Test the new keyboard by typing and ensuring all keys function correctly.

Replacing the Mouse: Before You Begin:

- Ensure you have a compatible replacement mouse that uses the same connection type (USB, wireless, etc.) as your existing setup.
- Make sure you have a clean workspace with enough room to work comfortably.
- Turn off your computer.

Step 4: Remove the Old Mouse:

1. If you have a wired mouse, unplug it from the USB port.
2. If you have a wireless mouse with a USB receiver, unplug the receiver.

Step 5: Connect the New Mouse:

- If you have a wired mouse, simply plug it into an available USB port on your computer.
- If you have a wireless mouse, follow the manufacturer's instructions to connect it to your computer. This usually involves turning on the mouse and pressing a sync button or entering a code, depending on the model.

Step 6: Test the New Mouse:

- Turn on your computer.
- Test the new mouse by moving the cursor and clicking the buttons to ensure all functions work
- correctly.

Final Steps: Dispose of the old keyboard and mouse responsibly by recycling or donating them if they are still in working condition.

Make any desired adjustments to the keyboard and mouse setÝngs through your computer's operating system, such as adjusting mouse sensitivity or keyboard layout.

That's it! You've successfully replaced your computer keyboard and mouse. If you experience any issues during the process or have trouble connecting the new devices, refer to the manufacturer's instructions or seek assistance from a knowledgeable friend or professional technician.

List of tools required for pc upgrades and maintenance and their uses

Performing PC upgrades and maintenance requires specific tools to ensure the process is efÏcient and safe. Here's a list of common tools and their uses:

1. Screwdriver Set:

- Uses: To remove and secure screws when opening and closing the computer case, securing components, and attaching or detaching hard drives and SSDs. 2. Anti-Static Wristband:
- Uses: To prevent electrostatic discharge (ESD) that can damage sensitive computer components. Attach it to your wrist and connect the other end to a grounded metal surface.

3. Needle-Nose Pliers:

- Uses: For holding and manipulating small components and cables in tight spaces, such as during cable management or when securing connectors. 4. Cable Ties or Velcro Straps:
- Uses: To bundle and organize cables neatly, improving airflow and reducing clutter inside the case.

5. Flashlight or Headlamp:

- Uses: To provide extra illumination when working in dark or hard-to-see areas inside the computer case.

6. Thermal Paste and Applicator (if needed):

- Uses: To apply thermal paste when replacing a CPU cooler or reseating the CPU. Helps in
- conducting heat between the CPU and cooler for eﬀicient cooling. 7. SATA or Data Cable (if needed):
- Uses: To connect storage drives (HDDs and SSDs) to the motherboard or other peripheral devices.

8. Power Supply Tester (optional):

- Uses: To check the functionality of a power supply unit (PSU) before installation or when diagnosing power-related issues. 9. Multimeter (optional):
- Uses: To measure voltage, current, and resistance. Useful for diagnosing electrical issues, testing power supplies, or troubleshooting circuitry.

10. ESD-Safe Work Surface or Mat:

- Uses: Provides a safe, static-free workspace for handling and assembling computer components.

11. Cleaning Supplies:

- Uses: Includes canned air, microfiber cloths, and screen cleaning solution for removing dust, dirt, and fingerprints from components and screens.

12. SATA Dock or External Enclosure (optional):

- Uses: For connecting and testing internal hard drives or SSDs externally. Useful for data recovery or backup purposes. 13. Case Speaker (optional):
- Uses: To connect to the motherboard's speaker header, allowing you to hear error beeps during POST (Power-On Self-Test) for troubleshooting purposes.

14. Spare Parts (optional):

- Uses: Having spare screws, standoffs, or other small components can be helpful in case
- you lose or damage them during the upgrade or maintenance process. 15. Magnifying Glass (optional):
- Uses: For inspecting small components and connectors closely, especially if you have diﬀiculty seeing fine details.

16. Soldering Iron and Solder (if advanced repairs are needed):

- Uses: To perform soldering work on circuit boards or components for advanced repairs or modifications.

17. Diagnostic Software and Tools (software-based):

- Uses: Various software tools can help diagnose hardware issues, check temperatures, and perform stress tests.

Having these tools on hand can make PC upgrades and maintenance tasks smoother and more efficient. Always follow safety precautions and consult component manuals or guides for specific instructions when performing PC upgrades or maintenance.

3.8 Summary

Computers, while powerful tools, often encounter a variety of issues that can hinder their performance and usability. Understanding how to diagnose and resolve these common problems is essential for maintaining an efficient and effective computing environment.

3.9 Assessment Questions

1. What are three common reasons for a computer's slow performance, and what steps can be taken to resolve each issue?
2. Given a scenario where a user reports that their printer is not responding, outline the troubleshooting steps you would take to diagnose and resolve the issue.
3. Which of the following is NOT a recommended step for resolving software crashes? a) Updating the application
   b) Restarting the computer
   c) Ignoring the issue
   d) Checking system compatibility
4. A user is experiencing frequent internet disconnections. Describe the process you would follow to troubleshoot this issue, including potential causes and solutions.